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PEAT FUEL IN RUSSIA.

(An abstract of a paper read before the Mechanical Engineers Section of the Polytechnical Society in Moscow, Russia, by John H. Gibson, Manager of Peat and Charcoal Manufacturing Plants of P. P. Demidoff's Successors Nijni-Taguil District, Government of Perm, Russia.

The deposits of peat in Russia are rather difficult to calculate. Count Vasiltchikoff in one of the official issues of the Ministry of Agriculture estimates the area of bogs in Russia at, approximately, 770,000 sk. kilometres. German statistical reports estimate the area at 350,000 sq. kilometres and, for Finland, 73,700 sq. kilometres.

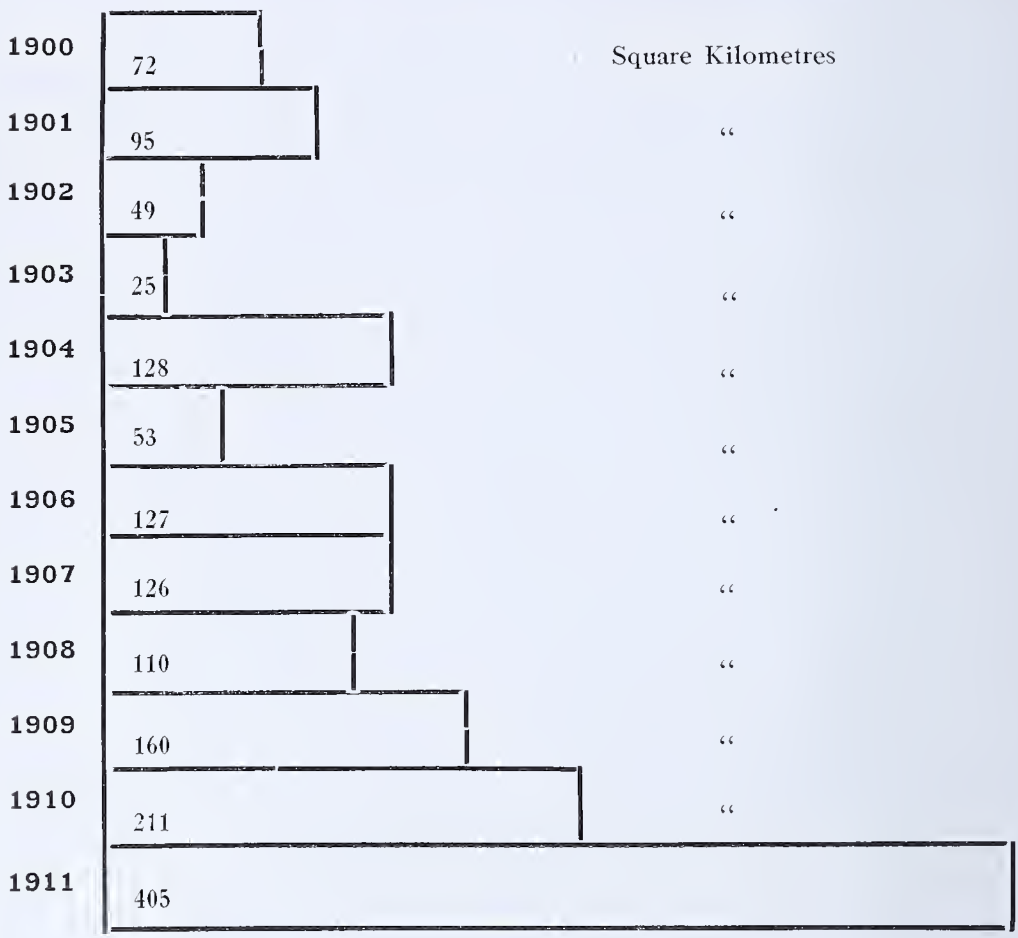
The records of the expedition of General Jilinsky mention 1355 sq. kilometres in only one government of Minsk. In Central Russia the area covered by the estuaries of the river Oka (i.e. Schva, Solodcha, Pra, Wokscha, etc.) includes 1760 sq. kilometres, and the basin of estuaries of the river Kliazma includes about 1100 sq. kilometres of peat bogs. The north-east side of the Government of Moscow and Tver has about 550 sq. kilometres. There is one particular peat bog, "Orschinsky Moh", which alone covers 1100 sq. kilometres.

The peat investigation branch of the Ministry of Agriculture has investigated about 1760 sq. kilometres of the government peat bogs as per diagram shown in Fig. 2. The peat deposits of the bogs investigated from 1882 up to 1911 contain 3,868,000,000 cubic metres of peat, or 1,289,000,000 cubic metres of air dried peat fuel. About 50% of the investigated areas belong to the Governments of Moscow, Vladimir, Tver, Riazan and Nijni-Novgorod, and are distributed as per diagram shown in Fig. 2. Comparing with the present output of 3,000,000 tons of air dried peat fuel per annum, the above quantity would last at least twenty years.

The peat industry in Russia as a commercial enterprise, had its beginning in the last quarter of the nineteenth century. However some pioneer work in developing the bogs was undertaken as early as the time of Peter the Great, who found the practical men for the industry in the classical peat country of Holland, and brought them over to Russia. In 1765 the Imperial Free Economical Society

inserted an article in its Journal on "Peat and its charring into coal," written by a Mr. Leman. Later the Society inaugurated a system of premiums to encourage the use of peat. As a result of the efforts of the Society many private people started their own peat lands; for instance, Count Kourakin in the Government of Orel, and Mr. Madox, an Englishman, in the Government of Smolensk, whose plant, situated in the Gjatsky District, had an output of 50,000 bricks of hand cut

Fig. 1. Area of Peat Bogs investigated in Central Russia viz, .years (1900-1911)



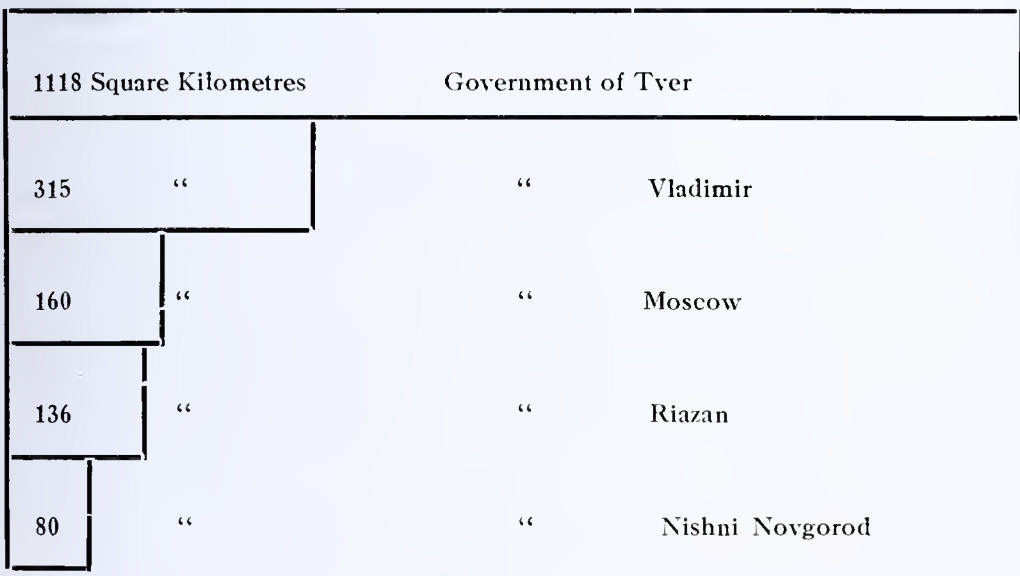
peat per annum in 1793. One of the first peat plants in the central region of Russia was installed by the government for the Ismaylowsky brick works near Moscow. In 1837 Count Kiseleff, Minister for the State Estates, issued a circular instructing the provincial offices of his department to collect information with regard to the peat industry, and two torfmeisters were brought from the Baltic provinces to investigate the peat bogs and superintend their working. In 1840 a decree was issued by the Emperor for the heating of the government

buildings at Moscow by peat instead of wood, and in 1851 a special committee was formed under the presidency of Count Zakrevsky, Governor General of Moscow, to work for the development of the peat industry.

For the successful achievement of this object the committee were empowered to support private enterprise by granting long date loans on easy terms. Shortly after the committee began its operations, 160,000 cubic metres of hand cut peat fuel were made at one of the peat bogs situated near Moscow, which was forwarded by order of the Governor General to the nearest fabriques. Large quantities of this peat were thrown aside, while the fabriques continued to use wood as before.

Up to 1870 only hand cut peat was made. In 1875 a government peat plant was erected in the Karatchewsky District of the Government of Orel, where

Fig 2. Area of Peat Bogs in Central Russia investigated by Government (1882-1911)



machines were used of the Gratzian-Pio and Dolberg types. With the extension of manufacturing industries and the consequently increased prices of wood, the use of peat fuel gradually became more and more extensive. Comparing the direction in which peat machine manufacturers in Russia and in other parts of Europe developed their machines it may be observed that in Russia efforts were principally devoted to introduction of better methods of cutting, mixing and pulping peat instead of increasing output and lessening the number of workmen employed. But the steady increase in wages and the great demand for skilled peat men have had the effect that endeavors are now being made to introduce in the peat industry "American methods," as they are called in Russia, i.e. to introduce more machinery and to lessen the labour. The machines most used in

Russia are those of Anrep design and similar types, but it may be said generally that there are as many types as installations. A new type which is spreading very rapidly now is the Hendune machine.

The output of machine peat is increasing year by year. In 1893 the output of eleven Governments (Vladimir, Moscow, Nijni-Novgorod, Riazan, Kursk, Tamboff, Perm, Warsaw, Kalish, Loublin and Petrokoff) was 1,100,000 tons. In 1908 the output of the Governments, produced by 73 peat plants was:—

1908	1,000,000 tons.
1909	1,075,000 tons
1910	1,230,000 tons

This peat is used exclusively by manufacturing industries (cotton and weaving mills, brick works, glass works, iron and steel works, etc. The late Aleph Anrep estimated that at the beginning of the present century 1300 peat machines were in use in Russia. If the average yearly production of a machine is assumed as being 5,000 cubic metres, which is rather a low figure, the production at that time must have been about 2,700,000 tons of air dried peat fuel per annum.

To give some idea of the size of some of the peat plants now operating in Russia, I may mention that of Morosoff, Son & Co. at Orehowo, near Moscow, where more than fifty machines are working every season, and a similar sized plant of the Electric Lighting Company recently started, and so on.

The scarcity and high prices of naphtha and coal, the two chief classes of fuel in Russia, have had the effect that peat fuel plants are now spreading all over the country by leaps and bounds. During the season of 1914, one peat machine manufacturer received orders for more than one hundred machines with equipment, another fifty, etc. Prospectors are travelling the country over in search of suitable peat bogs, and selling the information obtained at high prices. There is in fact a real boom in the peat industry. The retail price of machine peat in Moscow is now $4.80 per ton, instead of $3.00 per ton, three years ago.

MODERN METHODS OF UTILIZATION OF PEAT.

THE NEW PLANT AT CODIGORO, ITALY.

(Translated from Il Monitore Tecnico).

Near Codigoro, and not far from Po di Volano, where the land is from one to two meters below sea-level, are situated large areas of peat bog under conditions very favorable for industrial exploitation, with progressive drainage effected by a well-disposed network of canals. There in an area of about 1600 hectares eastward and westward to the town of Mezzogoro the bog has special characteristics: The bog is composed of fibrous peat, while the surface is pulverulent, and the nitrogen content is high. The average moisture, including fibrous peat and dust, does not exceed 60 per cent. Industrial treatment is thereby facilitated, and excavation, transportation and drying are easy and economical.

The development of such bogs has been attempted by various methods, most recently by the Societa La Codigoro, now in liquidation, who proposed an application well known in America, and to some extent also in Italy, viz., the employment of the dried peat powder for fertilizer purposes, and also installed a plant to produce briquettes of compressed peat. These attempts were unsuccessful.

As is generally the case with low grade fuels, badly supporting or not supporting perfectly the cost of transportation, and bringing comparatively low prices, the peat fuel was unable to meet successfully the competition of foreign coal, owing to defects due to its inherent properties. To render feasible, therefore, the working of the bogs, it is necessary to take advantage of other properties of the peat. It contains more or less nitrogen, derived from shrubs and plants, which is recoverable, and is often more valuable than the carbon. Moreover the tar contained can be recovered, while the ashes are rich in potash, soda, and other substances. The treatment necessary for such utilization must be made on the spot in establishments located at the bog, and the process to be adopted is that of gasification. The Mond process adopted permits the recovery of all the gas required for the needs of installation itself. With the maximum results, the nitrogen, converted into sulphate of ammonia, an excellent chemical fertilizer, tar, which may be distilled and refined to obtain paraffin and oils, more or less heavy, and other by-products, can be recovered.

The first idea of applying the by-product recovery process to utilize coal slack and screenings, which cannot conveniently be transported, by establishing plants located at the mines, was due to Dr. L. Mond. But the utilization of peat by this method, as suggested by Dr. Mond himself, presents some diffi-

culties. The first plant of the kind began operations in 1910 at Orentano in the Province of Firenze, to work the peat from Lake Bientina. It was designed by an English company, holders of the Mond patents, for the Society for the Utilization of Italian Fuels. Later notable changes were made by the Society's experts, and a plant completed for the preparation and artificial drying of the peat. A second important plant (in chronological order) followed afterwards at Osnabruck (Hanover) under the direction of Doctors Frank and Caro, but may be said to be in the experimental stage. Other plants of minor importance, designed by various firms, are in the tentative stage in England. As for these, they are struggling with difficulties.

After many researches and various experiments, the Society for the Utilization of Italian Fuels about the middle of 1912 revived the establishment of the Societa La Codigoro, and taking advantage of the careful studies made and the experience acquired at the Orentano plant, constructed and put in operation during the past year at Codigoro a new, large and complete plant, which is, besides that of Orentano, the only plant now in existence by which the difficult technical and economic problems connected with the utilization of the fuel can be said to be rationally solved.

These problems—already the object of long study and research with different methods and processes, especially outside of Italy, and thus now brought to solution by the labours of Italian experts—had the greater importance, since the bogs had been abandoned in all these places. Every one, therefore, will regard with special interest the plant at Codigoro, which for that reason merits special description.

The installation comprises essentially the bog and the plants for excavating and transporting the peat; the plant for preparing and drying it; the Mond plant for production of sulphate of ammonia; the briquetting plant and humus factory, constituting the old installation; and a central electric plant for the service of the establishment. These will be described separately.

The bogs controlled by the Society are two, one of 700 hectares, which belonged formerly to the Societa La Codigoro, near the establishment; the other of about 500 hectares, known as the Monticelli bog, at some distance from it. There are besides other small bog areas in the vicinity. The first is already entirely broken up for cultivation. The peat has an average depth of 50 to 60 centimeters with a maximum of one meter. It is easily worked, being on the surface gradually reduced to powder by the action of the sun and yearly plowing. The average moisture content is 58 per cent., the specific gravity about 0.70; that is to say, a cubic meter of freshly dug peat, including from the bottom to the surface dust, weighs about 700 kilograms and contains about 300 kilograms of dry peat. Practically it may be calculated that from 3 to 3.5 cubic meters of excavation is required to produce a ton of dry peat.

The digging is done by hand, and the workmen load directly into wagons

provided for transportation. The area to be excavated is surrounded by light railway tracks by which trains can arrive, stop and leave without loss of time, while one train is always being loaded. The length and width of the peat to be excavated are previously calculated on the basis of examinations made, and a gang of workmen day by days lays rails to serve for the following day, removing those nearest to the portion of the bog already excavated. The railway line which connects the field of excavation with the plant is double-tracked, and is constructed with very light rails, about 7 kilograms to the lineal meter, set on ties at 70 centimeters apart.

The branches of the movable tracks on the excavation are brought together on wide tables which form a continuous floor of support on the soft earth of the bog. The trains of ten or twelve wagons each are drawn on maximum grades of five per cent., by a locomotive, Klein patent, weighing in operation six tons, which can turn on a curve of less than ten meters radius. The small cars have a capacity of about 2.5 cubic meters, so that the train of ten to twelve cars can carry at each trip from 6 to 7 tons dry, that is to say, 14 to 18 tons of moist peat. The average quantity to be daily excavated and carried is from 700 to 800 cubic meters, that is to say the loads of about 400 small wagons. The railway plant has accordingly a capacity of over 1000 cubic meters daily.

Besides the hand digging, a mechanical excavator, designed specially for the plant by Dr. Wielandt, the noted specialist of Oldenburg, is being prepared and will soon be in service.

The machine can excavate more than 600 cubic meters in ten hours working. It is operated by electricity, and performs the labour of thirty men. The installations on the bog are completed by a network of electric wires at high tension (2500 volts), which follow all the principal roads. Canals excavated throughout the bog serve to keep the banks more or less dry, and, in addition, electrically operated centrifugal pumps facilitate the hydraulic regulation. Finally, there is from all points telephone communication with the works.

The drying of the peat—quite different from the practice elsewhere—is not effected by the sun, but artificially in continuous manner. The plant devoted thereto occupies all the west side of the works along the Bella canal, and comprises three large adjoining sheds, each provided with tracks on the outside and inside for arrival, unloading and departure of trains, with a conveyor for the peat, horizontal for 35 meters, and then inclined. At the sides two inclined planes serve to contain the peat unloaded from the cars, and to start it towards the conveyors, which turn it into a macerator formed by two drums revolving in opposite directions, and operated by an electric motor. The pulped peat which issues from the machine falls into a second similar machine from which it issues rendered more compact and closer, cut in small pieces which fall on metal screens which are loaded on special small cars. The

loaded cars are drawn mechanically on a conveyor operated by electricity, with an electric windlass for drawing the small cars, which brings them to the feed entrance of the drying chamber. The drying plant occupies an area of over 2000 square meters, and is divided into twelve galleries or chambers where the cars remain during a certain number of hours.

By means of a conveyor like the one already mentioned they are then carried under a broad roof, where the screens containing the dried peat are unloaded on a double inclined floor, along the centre of which runs a conveyor of iron boxes, which for 60 meters is horizontal and for 36 meters is inclined, and serves to elevate the peat to the producers. The drying is accomplished at the expense of the products of combustion of the gas or of the tar recovered from the peat itself in the manner hereafter described, gar and tar which are burned for the heating of the water in the boilers, and in an additional furnace to produce the necessary heat. The hot products of combustion are blown by electric fans across a subterranean passage to the drying chambers, where they are suitably mixed with outside air for regulation of the temperature.

The dryers at Codigoro are adapted to evaporate up to 200 tons of water daily, and have been designed on the basis of experiments made and results obtained at Orentano.

The plant for gasification of the peat and production of sulphate of ammonia consists of the gas producers, the towers for recovery and washing, the circulating tanks, and the vacuum plant for concentration and crystallization of the sulphate of ammonia, and operates on a principle which may be briefly described.

To obtain Mond gas, that is to say a gas of special composition which best facilitates the recovery of ammonia, the mass of peat in the gas producer where it is partly burned, is exposed to a jet of warm air saturated with water vapour. The dissociation of this in the presence of the glowing mass produces a gas which has about 10 per cent. of carbon dioxide, a little less than 20 per cent. of carbon monoxide, from 25 to 26 per cent. of hydrogen, and from 4 to 5 per cent. of methane; that is to say, about 40 per cent. of combustible gas. Varying the temperature of the mixture of air and vapor, the composition of the gas also varies. The gas thus produced is first washed in a vessel with mechanical agitators, where it deposits a first part of the tar, and then passes into another vessel, followisg a sinuous course to give up the water in suspension; thence it traverses from the bottom to the top a lead tower with wood bafflings and meets in its passage a fine spray of sulphuric acid, or of a diluted solution of sulphate of ammonia which absorbs the ammonia, altering it into sulphate of ammonia.

The gas issues from this tower free from all traces of ammonia and redescends to rise again in a second tower, similar to the first but of iron, where it meets instead a spray of cold water, which is heated in washing the gas.

The gas having again yielded part of its heat to this water, redescends and rises once more into a third tower identical with the preceding one, where it meets another spray of water which completes the cooling. Thus purified and cooled it is used as burning gas for the boilers, and for heating the dryers, and could serve (previous to other washing and drying) for the operation of the gas engines.

The acid solution which has traversed the lead tower falls into a lead vat in which it deposits the free tar, and is pumped by a lead centrifugal and blown into the top of the tower, continuing to circulate in a manner which gradually increases its saturation. From time to time such vats are emptied into other similar vats from which the saturated solution of sulphate of ammonia then passes to the concentrating apparatus, while it unites continually in the first circulating tank with new sulphuric acid intended to fix the ammonia.

The water which has circulated through the iron towers falls into a vessel in which it also gives up tar, and is afterwards recovered and pumped into a fourth tower in which it meets a column of air forced from a centrifugal fan at high pressure. This air becoming warm cools the water which returns then to circulate in the second tower, thus establishing a closed circuit, and serving as vehicle for the heat, which withdrawn from the gas reheats the air. This air, reheated and moistened, is again added to the vapor and again reheated, and, forced into the gas producer, serves to generate the gas.

The water from the third tower can be drawn off after having deposited its tar, but the third tower can also be put in circuit with the second and fourth towers, forming a continuous circulation by means of the vats and the pumps, in which the water is heated while passing through the second and third towers, and is cooled in circulating through the fourth tower.

At Codigoro there are six gas producers of the type indicated.

The towers are 18 metres high, and have a diameter of about three metres each.

The removal of the ashes is of very great importance, for the reason that the peat contains 20 to 30 per cent. It is done every hour by hand, but means are being devised for doing it mechanically.

The gas producers can gasify 30 tons of peat each in 24 hours. The moisture of the peat which is introduced into them does not exceed 30 to 35 per cent. With a consumption of 150 tons of peat there can be produced daily about 270,000 cubic metres of gas of about 1400 calories. With the average nitrogen content stated there can be obtained practically 80 kilograms of sulphate of ammonia per ton of peat, that is, about 120 quintals per day, with a consumption of acid of about 150 quintals daily at 56° Be.

The plant for concentration of the sulphate consists of two vacuum evapor-

ators, a vacuum pump with superficial condensor, the pumps for the raising of the solution, and a centrifugal for drying the crystallized sulphate.

The solution of sulphate of ammonia of proper density which is in a large vat situated at the bottom of the works is raised by a centrifugal pump and plunged into the concentrator. In the concentrator and on the outside of its tubes circulates steam proceeding through an exhaust from the steam turbine at the central electric station, while the water evaporated from the solution is blown into the condenser. When the solution is concentrated, it is drawn off from the evaporator and dried in the centrifugal machine, and the sulphate falls into small wagons in readiness to cary it to the storehouse. At every operation with the centrifugal machine two quintals of sulphate are dried.

In a laboratory near the gas producers the chemical analyses for control of operation of the whole plant are continuously made.

On account of the large daily consumption of sulphuric acid and the high cost of transport, it appeared desirable to provide for its manufacture on the spot. The plant for the purpose occupies a building at some distance from the remainder of the installation with which it is united by subterranean lead pipes to conduct the acid to the circulating tanks. It contains the Herçshoff furnaces, with the dust chamber, the auxiliary machines, and an oil engine in reserve to the electric motors, and, under a broad roof, the Glover and Gay Lussac towers and three lead chambers of 2,000 cubic metres capacity. A Kestner plant di monta-acidi and a plant to use nitrate of soda or nitric acid complete the installation which has a capacity of 150 quintals of acid daily working normally. The central thermo-electric plant which furnishes the energy required for all the services of the plant is equipped with two boilers and two turbo-generators.

The boilers are at present two in number, Tosi type, of 190 square metres heating surface each at 13 atmospheres, with superheating of the steam to 325 degrees. A third of about 350 square metres heating surface is in course of installation. They are heated with the gas itself, or, exceptionally, with the tar recovered from the peat. On the front of each boiler are three gas burners and three tar burners, Koerting system. The gas burners are large Bunsen burners in which the flow of air can be regulated in the same way as laboratory Bunsen burners. The tar, kept liquid by steam passing through a coil, is contained in a vessel placed above, and passes to the burners through tubes arranged along the front of the boilers. Steam issuing from the orifice of the burner draws and splits up the tar which is burned in the interior of the furnace. Exhaust steam is condensed to furnish part of the water supply for the boilers, the remainder being drawn from the Goro river, from which water for all purposes is pumped, collected in reservoirs and purified before distribution.

The turbo-generators are two in number, Tosi-Oerlikon, of 1000 amperes, 225 volts, three phase, 50 cycles, 3000 revolutions, with exciters coupled, with steam at a pressure of 12 atmospheres superheated to 300°, free exhaust, one being held in reserve to the other. The exhaust steam is utilized for the gasification and for the concentration of the sulphate, furnishing pure steam, dry and without oil. At the rate of about 6 tons per hour of peat gasified about 6000 kilograms of steam hourly is required for both services and the whole plant has been designed to avoid waste or deficiency. The consumption of the two turbo-generators is such as to require all the steam necessary for the production of the gas and the sulphate. With free exhaust the turbines consume from 16 to 20 kilograms of steam per kilowatt hour produced. The air for cooling the generators is filtered, and the warm air which issues from the generators and all the heat emanating from the tubes are blown through one of the two electric centrifugal fans, one in reserve to the other, which convey air, under about 1000 mm. pressure, to the producers.

For the daily production of steam it is calculated that the gas developed from 50 to 60 tons of peat should be utilized, but about 30 to 40 million calories are daily recovered in the products of combustion which are utilized for the drying. From the whole of the gas produced there remains a not inconsiderable amount which can be sold.

The electric energy produced by the turbo-generators serves to operate all the inside equipment, elevators, carriers, fans, pumps, and for lighting, and also for the outside services, aided by another generator located in the briquetting works. The entire complement of motors in the installation require from 900 to 1000 amperes at 225 volts, and the turbo-generator always runs at full load. The total consumption of the installation is about 7000 kilowatt hours daily.

Alongside all these new plants the old establishment (the age of which, however, does not exceed six or seven years) constructed by the Societa La Codigoro continues the production of humus and compressed peat briquettes in the quantities required by the market for these products.

The installation comprises two boilers (Cornovoglia) of 100 square metres heating surface, which formerly had special grates for burning peat directly, and can now burn gas or tar; the mill for grinding the peat and reducing it to fine powder, with the necessary equipment of elevators and conveyors: the Zeitzer steam dryers, to dry the peat dust thoroughly; and the briquetting press. In addition there are two horizontal steam engines for control of the transmission, and the turbo-generator which serves for the outside services as above mentioned.

They utilize now with the plant the detritus of the peat already dried, completing the drying with the Zeitzer where necessary, and sifting to obtain the humus, which is used mixed with animal manures or chemical fertilizers.

The boilers serve also as reserve to the new plant, and are connected with the Tosi boilers at the central electric station. Being áble to burn coal, they serve also for starting.

The establishment consists besides of a machine shop and a woodworking shop specially designed to meet the numerous requirements of the operations. And includes also various buildings for storehouses, for workshops, for residences of the management and the workmen, and two large filtration tanks of over 10,000 square metres.

In its entirety the establishment and surroundings occupy 90,000 square metres, of which 20,000 are taken up by the houses of the management and the filtration tanks, and 70,000 are covered by the buildings and industrial machines, or set apart as storage space.

The bottom on which the bank of peat rests is clayey and quite undulating, owing to which it is, after removal of the peat, no longer suitable for cultivation. It is necessary, therefore, in the first place, to level it in such a manner as not to alter the regulating plane of improvement. Once the bottom is levelled and the canals opened it is necessary to provide for deep plowing which is done by means of a Violati & Tescari electric plow, and with ordinary tillage; and for the correction of the land with chemical fertilizers and other correctives of the kind.

Experiments are being made in improved culture and eventually the ground recovered will be divided into small parcels and houses constructed, which will contribute to solve the social problem of the district.

Except for a few machines specially imported from England and Germany, everything has been constructed in Italy. The plant as described is a typical example of the closed circuit of recovery. The peat produces gas and by means of the gas so produced the peat is dried. As gas it produces steam, and the steam after having developed the electric energy needed for all the servics of the installation, serves to produce gas. The heat of the gas is used to warm the wash waters, which in their turn are cooled warming the air necessary for the gasification. It is evident that a plant of this kind must be designed and calculated with the greatest skill and attention, since a trifle is enough to break the continuity of the circuit.

The Codigoro plant, as also that of Orentano, demonstrate that peat, which it is so generally sought to destroy in order to improve the agricultural condition of the soil, can with proper treatment be converted into wealth; also that such treatment of the peat as described can greatly aid in the solution of another problem of the greatest national importance, that of the improvement of marsh lands, which very often are also peat bogs. In that case a work of improvement which otherwise might be indefinitely delayed may be rendered immediately remunerative.

CANADA'S PEAT BOGS A VALUABLE ASSET.

Attention is being drawn to the possibility of expansion of Canadian commerce and industry as a result of the war. This may take the form of domestic production of articles for a supply of which we have been dependent upon foreign sources, or of increased exports to other countries of products hitherto supplied by Germany and Austria.

Among other things this emphasizes the importance which development of the latent resources of Canadian peat bogs might readily assume if full advantage of the new conditions arising from the war were taken.

Sulphate of Ammonia, the chief by-product of European peat plants, is a valuable fertilizer worth about $60.00 per ton. The world's production last year is estimated at 1,365,000 tons, worth about $80,000,000. The chief importing countries are as follows, the figures representing excess of consumption over production:—

	Tons	Value
United States and Canada	58,000	$3,500,000
Japan	115,000	7,000,000
Java	57,000	3,500,000
France	15,000	900,000
Spain and Portugal	42,000	2,500,000
Italy	15,000	900,000
	302,000	$18,300,000

Of these amounts the portion supplied by Germany and Austria was:—

	Tons	Value
Germany	90,000	$5,400,000
Austria	30,000	1,800,000
	120,000	$7,200,000

plied, in part at least, by Canada, and of an opportunity to capture some share of the trade of Germany and Austria in this product.

The extent and rapid growth of the domestic market for artificial fertilizers is shewn by the following statement of Canadian imports for 1902 and 1903 and the past six years.

Year	Value
1902	$ 84,996
1903	112,256
1908	403,171
1909	529,660
1910	548,493
1911	586,453
1912	620,147
1913	737,656

Many Canadian peat bogs are rich in nitrogen, and therefore suitable for this industry, and enquiries have already been made by British capitalists with a view to establishing chemical works in Canada, provided that a sufficient supply of peat can be guaranteed.

Apart from the potential value of our peat bogs as a subsidiary source of fuel supply and for production of sulphate of ammonia, there are numerous other products such as moss litter, peat dust, alcohol, acetic acid, acetone, tar, tar oils, creosote, etc., which might form the basis of paying industries giving employment to many people, where now we have only waste lands.

In the peat bogs of Northern Holland alone it is stated that about $3,000,000 worth of peat fuel is made yearly, and over 200,000 tons of peat moss litter. About 10,000 families are employed in the peat fields, and many prosperous towns owe their existence and prosperity to the industry. In addition to shipments made by rail, it is estimated that peat furnishes annually about 48,000 cargoes to the Dutch canal boats.—*Journal of the Canadian Peat Society.*

UTILIZATION OF PEAT LAND FOR CRANBERRY CULTURE.*

*Published by permission of the U. S. Assistant Secretary of Agriculture.

By Dr. C. L. Shear, U.S. Department of Agriculture, Washington, D.C.

At the outset, it should be distinctly understood that cranberry growing is a very specialized branch of horticulture and requires special knowledge and experience in addition to the usual qualifications essential for success in any branch of agriculture. I can attempt in the time at my disposal only to give a general outline of the subject, sufficient, I hope, to permit the owner of peat land to decide whether cranberry growing gives sufficient promise of profit under his conditions and circumstances to justify further investigation.

The essentials for successful and profitable cranberry culture are (1) a good peat soil; (2) a sufficient water supply; (3) proper drainage facilities; (4) a convenient supply of sand; (5) accessible transportation facilities; (6) experienced and competent management. It is assumed, of course, that there is sufficient capital available for the proper development of the project.

1. THE SOIL. The cranberry differs from most cultivated fruits by requiring an acid peat soil for its best development. It will grow on all kinds of peat or muck but does best on a fairly well decomposed peat or muck. The tendency of the plant on coarse peat is to develop an excessive growth of vine. However, this defect can usually be controlled by drainage, sanding, and pruning. The more uniform the condition and depth of the peat the better it is for cranberry culture.

2. THE WATER SUPPLY. A sufficient water supply is essential to the *growth* of the cranberry and is absolutely necessary for its proper protection from frosts and insects, and for irrigation when required. It is also regarded as important to keep a bog flooded during the winter to prevent winter injury and heaving out of the plants and to retard early blooming in the spring. The most important use of water in the north, however, is for frost protection, as there is a possibility of frost injury almost every month in the growing season. A frost on the 8th of August, 1904, is said to have destroyed half the crop in Wisconsin. Water may be stored in a reservoir above the bog or it may be obtained from a lake where a dam can be conveniently located at the outlet, or by pumping, where a gravity system is impracticable. The water supply should be under such control that the bog can be flooded within a few hours. Flooding is also a satisfactory method of destroying certain insect enemies of the cranberry.

3. DRAINAGE. The ordinary peat bog in its natural condition is usually supplied with a greater amount of water than is best for profitable fruit production, and the supply is usually not uniformly distributed. This necessitates damming, grading, and ditching in order to hold the water at just the level in

the soil that will provide optimum conditions for fruit production. The size and number of ditches will depend on the area and shape of the bog. Too much care cannot be expended in providing proper ditches. These should permit the lowering of the water to 3 feet at the lowest point on the bog if necessary. Improper drainage is a frequent cause of failure in cranberry culture. Improperly drained bogs tend to produce an excessive growth of vines and light crops of fruit. Excessive moisture also greatly favors the development of many troublesome weeds and certain fungous diseases of the cranberry.

4. THE SAND. An ample supply of sand is essential to the proper preparation and maintenance of a cranberry bog, especially in a region where frost is one of the great enemies of the cranberry growth. After the peat has been scalped and graded, a 2 or 3 inch layer of sand, the coarser the better, should be spread over the surface of the bog. This is very helpful in keeping down the growth of weeds while the vines are starting, and also helps to protect the bog from frost injury, as it has been found by exact records made in Wisconsin that the temperature at the surface of a sanded bog is 5° to 10° higher than on an unsanded bog. In a critical frost period this difference would mean the loss of the crop on an unsanded bog unless the bog should be quickly flooded.

5. TRANSPORTATION FACILITIES. Cranberries must usually be shipped for sale in more or less distant markets, and hence convenient railroad facilities are important. Hauling long distances over poor roads is not only expensive but is likely to injure the fruit by subjecting it to varying degrees of temperature and moisture and bruising.

6. THE MANAGEMENT. Although proper soil, water supply, drainage, sand, and transportation facilities may be available, the project may still be a failure without competent management. The manager is frequently the controlling factor in determining the profit or loss in any business, especially in cranberry growing. A successful manager and grower, if the two functions be combined, must have had experience in cranberry culture under the most improved conditions and methods or must have given considerable time and study to the subject on a good cranberry bog. In addition, he must possess good business ability in order to handle and dispose of the crops profitably and to control the necessary expenses involved.

I cannot attempt to discuss in detail how a cranberry bog should be developed and maintained, as this would require a small volume. Fortunately, this information can be obtained from the various experiment station publications and bulletins from the Department of Agriculture. The following bulletins may be consulted: U. S. Department of Agriculture Farmers' Bulletin 176, "Cranberry Culture;" Wisconsin Experiment Station Bulletins 119, 213, and 219; also, "Cranberry Culture," by Joseph J. White, published by Orange Judd Co., New York.

The first step in cranberry growing, if you already possess the land, is to have a survey made under the direction of a cranberry expert in order to locate the necessary dams, ditches, and grades and provide for drainage. The number and size of the ditches will depend somewhat on circumstances. After the main dams and ditches have been made, the next operation is the clearing of the land. If there are few or no large trees or shrubs present, the clearing and turfing can be done at a minimum expense. All shrubs, trees, brush, and stumps should be removed and burned and then the turf scalped to the depth of about 3 to 6 inches. This may be done by hand labor with mattocks and turf knives or by the help of some of the scalping plows and turf cutters that are in use. Much of the turf taken from the bog can be used in the construction of cross dams.

After the bog has been dammed, ditched, turfed, and graded, the next operation is to apply a 2 or 3 inch layer of sand. This is sometimes done with wheelbarrows if the areas are small and the sand very convenient; on larger bogs movable tracks and dirt cars are used; or in winter sleds may be used. After the bog has been sanded, which should be done in the fall or winter, it is ready for planting. This should be done in the spring, and special care should be taken to procure the best varieties and best cuttings obtainable. The rather general practice among cranberry growers of using old and diseased vines for planting purposes cannot be too strongly condemned. Insist on getting vigorous, healthy cuttings of unmixed varieties. Unfortunately, under present commercial conditions, varieties are so generally mixed that it is sometimes difficult to get strictly pure stock.

As to the best varieties, those that have been found most successful in Wisconsin will probably prove equally good for Minnesota. Among these may be mentioned the Prolific, Searls' Jumbo, McFarlin, Metallic Bell, and Bennett Jumbo.

After a bog has been properly established the cost of maintenance consists chiefly in weeding, which should be thoroughly done from the beginning, occasionally resanding, and pruning the vines. With proper attention a bog may be kept bearing indefinitely. There are bogs in Massachusetts 50 to 75 years old still in good condition.

To one not familiar with the cranberry business the various operations and requirements mentioned may appear rather discouraging, and one is naturally about to inquire what it will all cost and what may be reasonably expected in the way of profits. Reliable statistics bearing on these questions are not numerous. Lest anyone should have too high expectations the statement may be safely made that there are no millionaires known at present who have derived their wealth from cranberry growing. Some data have been collected in Wisconsin* which may be taken as a fair example of what may be expected with proper equipment and management. Following is a statement of the minimum and maximum cost per acre of establishing a bog:

*Malde, O. G., Cranberry-bog construction for Wisconsin. Bull. 213, Wisconsin Agri. Exp. Sta., 1911.

DATA SHOWING COSTS FOR AN ACRE OF CRANBERRY BOG.

Clearing land	$ 5	to	$ 75
Scalping, picking up, and constructing dams	35	to	75
Ditching	15	to	30
Flumes: Material	7	to	20
Labor	5	to	15
Sanding, 3 inches deep (12½ to 25 cents per cu. yd.)	50	to	100
Vines	65	to	250
Planting	15	to	30
	$197	to	$595

This shows that the cost usually ranges from $200 to $600 per acre, depending largely on the land clearing necessary, the size and area of the bog, and the availability of sand and other materials.

In regard to possible profits the data following are also derived from Wisconsin* from the report of a bog of 6 acres which had been under clean cultivation. The figures represent the average for four years, and are as follows:

*Malde, O. G., Cranberry-bog management for Wisconsin. Bull. 219, Wisconsin, Agri. Agri. Sta., 1912.

DATA SHOWING PROFITS FROM A CRANBERRY BOG.

Yield in barrels, per acre, average	94
Price per barrel f. o. b. shipping point	$ 7.50
Gross earnings per acre	728.33
Net earnings per acre, counting $2.50 per barrel as cost of production	493.33

A good cranberry bog under proper condition and treatment should produce an average crop of 50 to 100 barrels per acre. The prices usually fluctuate between $5.50 and $7.50 per barrel. The cost of production usually ranges between $2.50 and $3 per barrel. $100 to $300 per acre net is a reasonable expectation under good conditions and management. Of course, one sometimes hears stories of $1,000 having been cleared from an acre of cranberries, and under exceptional circumstances in an exceptional year such a profit might perhaps be realized, but cannot be reasonably expected or made the basis of undertaking the cranberry business.

SASKATCHEWAN COAL, BRICK AND POWER CO., LTD.

As a sequel to the operations carried on by the government of Saskatchewan at the lignite testing plant at Estevan, a limited stock company has recently been formed to manufacture lignite fuel and other products at Shand, Sask., about thirty miles south-east of Estevan on the main line of the C.P.R. between Moose Jaw and St. Paul.

The authorized capital of the company is $300,000, and it numbers among its directors prominent citizens of Regina, Moosejaw, Estevan, and other places. It is proposed to acquire about 300 acres of coal lands, on which there are estimated to be upwards of 4,000,000 tons of mineable lignite of excellent quality. The principal seam which is now being mined is nine feet thick and eighty feet below the surface. There is at present on the land a plant for mining coal and making wire cut brick, with a capacity of 500 tons of lignite and 50,000 brick per day.

The Company propose to produce:

1.—*Dried Lignite* for use with automatic stokers and in fuel gas producers.

2.—*Powdered Fuel* from the dried pulverized lignite.

3.—*Dried Lignite Briquettes* for use in large hand-fired furnaces.

4.—*Carbonized Lignite* for use in power gas producers.

5.—*Carbonized Lignite Briquettes* for domestic service.

6.—*Gas*, which may be sold as "town gas," utilized for production of cheap electrical power, or for burning clay products.

7.—Power, derived from the surplus gas generated in the carbonizing process.

8.—*Sulphate of Ammonia*, of which about 15 lbs. are procured from each ton of lignite.

9.—*Tar Products.* At the outset only simple distillation products will be procured, such as fuel oil, creosote and other oils and pitch. Later it is proposed to manufacture various synthetic chemical products.

10.—*Clay Products.* Eventually it is expected a complete line of common, face and ornamental brick, hollow ware, partition, floor and roof tiling, sewer pipe, drain tile, and many kinds of common pottery will be manufactured.

A brochure issued by the company points out that tar products have heretofore come from Germany. The total export of Germany's coal tar industry in 1913 is said to have been $55,264,522, produced by twenty-two factories, whose average dividends were 21.74 per cent. It is estimated that electric power can be

generated at very low cost, and that eventually the government of Saskatchewan will undertake the distribution of power over its own transmission lines in the same manner as Niagara water power is now distributed over Ontario by the Hydro-Electric Commission.

The lignite on the company's property is said to be of excellent quality as shewn by analysis:

Volatile matter	37.5	per cent.
Fixed carbon	54.5	per cent.
Ash	8.	per cent.
	100.	

Calorific value of dried lignite, 11,000 B.T.U.

Percentages determined on dry basis.

The southern part of Saskatchewan will furnish billions of tons of lignite. Only about 200,000 tons are now mined annually, while 2,000,000 tons of eastern and western coals are imported at high cost into the territory naturally tributary to this source of supply. When local lignite areas and accompanying clay deposits are developed, millions of dollars which would otherwise be sent out of the Province annually for fuel and building materials will be kept at home.

The effort to commercialize this industry in Saskatchewan will be watched with interest, and it is to be hoped it may prove as successful as its promoters anticipate. The Provinces of Ontario and Quebec, unfortunately do not possess such stores of lignite as Saskatchewan, but they have immense areas of peat bogs which if developed along similar lines would yield great quantities of excellent fuel and by-products in the main similar to those from lignite. The governments of those provinces might well take a leaf from the book of the Saskatchewan government, and take some active measures to develop the latent resources of their peat areas.

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AMERICAN PEAT SOCIETY MEETING.

We have great pleasure in calling attention of our members and other readers of the Journal to the meeting of the American Peat Society to be held in Detroit on September 20th, 21st, and 22nd.

The Canadian Peat Society had its inception in Ottawa on the occasion of a gathering of the members of the American Peat Society at the Capital of the Dominion in 1910. In that year Dr. E. Haanel, Dominion Director of Mines, held the position of President of the American Peat Society, and in his honour the Society's meeting was held in Ottawa, and the members were afterwards taken to Alfred, Ont., by special train, where they inspected the Government demonstration peat fuel plant then in successful operation. Notable addresses

were delivered at the meetings and at the banquet held at the Victoria Hotel, Aylmer, by Sir Clifford Sifton, Chairman of the Commission of Conservation, Hon. Sidney Fisher, Minister of Agriculture, Dr. Haanel, Director of Mines, Hon. J. G. Foster, United States Consul General at Ottawa, Professor Charles Davis of the United States Bureau of Mines and others, and the gathering was in many respects a memorable one in the annals of the peat industry.

Ever since the foundation of the Canadian Society a most cordial relationship between the two bodies has always subsisted, and this has been especially marked by the more or less international character of succeeding meetings. At New York and Kalamazoo the Canadian Society was represented, and in August, 1913, the friendly relations of the two societies were still further cemented by the holding of a joint meeting in the City of Montreal, when the peat fuel plants operating at Alfred, Ont., and Farnham, Que., under private control, were visited by many of those present.

Last year the American Peat Society was convened at Duluth, and had it not been for the outbreak of war a few weeks previous, and the temporary unsettlement of business affairs, there is no doubt a substantial representation of Canadians would have been present. Now that Detroit has been chosen as the next place of meeting, a point so conveniently situated on the border, it is to be hoped that as many as possible of our members will make a point of being present.

These meetings have in the past proved most useful and insructive, and of great value due to the interchange of experiences and opinions of operators in peat along different lines from all parts of the continent. They have grown in interest from year to year, and the meeting at Detroit is likely to turn out the culminating one of the series so far, if we may judge from the well-known energy and enthusiasm of the President, Mr. Carl Kleinstueck of Kalamazoo, Michigan, who for years past has been an ardent devotee of the peat industry.

Every Canadian who desires to see the latent resources of our peat bogs developed, and who can arrange to visit Detroit at the time mentioned, should not fail to attend. The programme of papers will be announced later. An exhibition of peat products will lend additional interest to the meetings. Further particulars may be learned by addressing Julius Bordollo, Secretary of the American Peat Society, Knightsbridge, New York City, or the Secretary of the Canadian Peat Society, Castle Building, Ottawa.

NEW USE FOR PEAT IN SAVING FARMYARD MANURE.

One of the most interesting problems in farming is the proper storage and fermentation of farmyard manure in connection with manure pits and covered courts; it has been the subject of much careful study and ample discussion, but it has not yet been satisfactorily solved, as both open pits and covered courts have each their advantage and disadvantages.

Dr. Guiseppe Beccari, of Florence, Italy, has proposed and patented a new system of fermenting manure in so-called "turret covered-courts" (concimaia a torretta) which differ considerably from other similar structures now in use. It is based on two new principles:

1.—Of fermenting the manure in a closed space so that it attains immediately the high temperature of 158 to 167° F., evolving abundant ammonia compounds and preventing the development and action of denitrifying bacteria and consequent loss of nitrogen.

2.—Of collecting the volatile ammonia compounds which in other dung-pits are, for the most part, lost in the atmosphere, while with this system they are led into a special chamber (the turret) where they are transferred into stable ammonia salts or nitrates, by suitable absorbents, such as clayey earth, peat, charcoal, gypsum, acid, superphosphates or an alkaline medium, etc., and at the same time favour the development of numerous colonies of nitrifying bacteria.

The turret covered-court is a masonry structure rectangular in plan, of an area proportionate to the amount of manure to be treated, and divided internally into two compartments. The floor is paved and is provided with drains covered by perforated bricks, through which air passes upwards into the dung from the ventilation drain, while the liquid manure oozes through it into the tank.

In the top of each compartment there is a trap-opening through which the manure is thrown as it issues from the stables. Between the two trap-openings is situated a turret, with the object of collecting and fixing the ammonia compounds evolved from the fermenting manure. In the turret a series of shelves placed above each other and fixed alternately to either side so as to leave a serpentine passage for the ammoniacal vapors are charged with peat or other absorbent materials which are collected from time to time through a door in the turret, which has also openings at top and bottom for admission and escape of air.

The manure as it leaves the stables, is thrown into the compartments and freely sprinkled every four or five days with liquid manure from the tank, and in 45 to 50 days it is completely decomposed and ready for use, and can be removed through the doors in each compartment.

Manure made in this way has been found to contain from 0.54 to 0.89 per cent. of nitrogen, while manure made in the usual way is considered good when it contains 0.45 per cent. Besides this there is also the nitrogen fixed as ammoniacal or nitric nitrogen by the absorbents in the turret.

From the hygienic point of view, also, this system is much superior to any other. It has been adopted in several parts of Tuscany, where the cost of erecting such a covered court sufficient for 8 or 10 head of cattle is about £27. —Monthly Bulletin of Agricultural Intelligence, International Institute of Agriculture.

The importance of the adoption of better methods of saving farmyard manure is generally not sufficiently recognized. It has been estimated that the total value of the manure produced yearly by farm animals in Canada is about $233,000,000. This is more than the value of the wheat crop of the Dominion, or of our entire mineral production or forest products.

Total wheat crop, 1914	$196,000,000
Total forest products, 1911	$180,000,000
Total mineral products, 1913	$145,000,000
Farmyard manure (average five years)	$233,000,000

The figures for the first three are for the years in which the value of each product reached the highest mark.

By the methods usually followed in this country it is conservative to estimate that at least one-third of the value of the manure is lost by defective storage. This represents an annual loss to the farmers of Canada through this source alone of upwards of $75,000,000. And as manure is so much raw crop material it involves crop production much lower than should be obtained were proper measures taken to conserve manure.

The use of peat as litter in stables is well known, and it has proved very satisfactory for that purpose wherever employed. There can be no doubt that under proper conditions peat might be very profitably employed in the conservation of the values of farmyard manure as above indicated.

The late Thomas McFarlane, formerly Dominion Analyst, in a paper read before the Royal Society of Canada in 1904 (See Journal of the Canadian Peat Society, Vol. II., No. 3, page 25), discussed the loss of substances useful as plant food in manures, in the course of which he said:

> "These results lend confirmation to the idea already expressed that urea " in decomposing under the above described circumstances is not all " resolved into carbonic acid and ammonia, but that a varying quantity of " nitrogen escapes in the free state. The presence of acid and neutral " substances capable of fixing ammonia does not prevent this and the " development of nitrogen seems to be owing to the excess of air."
>
> " There cannot be any doubt that in the ordinary treatment of barn- " yard manure the same influences are at work, and that in spite of the " presence of substances capable of retaining ammonia, losses of nitrogen " take place when the manure heaps are allowed too great a degree of " porosity."

The present campaign to increase agricultural production in Canada will have imperfectly met its ends unless due attention is given to the waste of valuable raw materials involved in the ordinary methods of disposal and care of the manure from farm animals. And in this connection it is most desirable that the properties and economic value of peat for such purposes as above described should be carefully investigated.

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BACTERIZED PEAT—A NEW FERTILIZER.

"The farmer, after all, stands for the necessities.".

"In the great household of Nature, the farmer stands at the door of the bread room, and weighs to each man his loaf."

—Hon. Martin Burrell, before the Ottawa Canadian Club.

"The survey of the Committee on Lands has brought out the fact that if farmers on the average would farm as well as the fifty best farmers whose farms have been surveyed, the result would be the doubling of the quantity of field crops from the land now occupied in Canada within a period of three years. Since the valuation of field crops in Canada ranges from $507,000,000 to $550,000,000 per annum, the importance of that possibility is seen."

Dr. J. W. Robertson, Commission of Conservation Agricultural Survey, 1910.

The present war has forcibly driven home the fact that the products of the soil are the mainstay of Canada's prosperity. The necessity for intelligent appreciation of the relation of the continued fertility of the soil to increased production was never greater than now. Crops must be fed as well as stock. Under farming conditions the supplies of available plant food stored in the soil are soon exhausted or greatly reduced, and unless these are replaced the plants in the field will starve as surely as would the cow in the stable if deprived of its daily ration of food. Looking at the matter in another light, fertilizers are the raw materials of the farm factory, and where they are not supplied crop production must fall off as the natural fertility of the soil is exhausted by cropping. The discovery, therefore, by an English scientist that great areas of peat now lying useless throughout the country may be turned into a highly concentrated and valuable fertilizer, bids fair to rank as the most important recent development in the science of agriculture.

The Fertilizer Problem.

Plant life demands unlimited supplies of carbon and nitrogen. The former, in the form of carbon dioxide, is everywhere present in the air, and under the influence of sunlight is readily assimilated by plants through the agency of their

The Spirit of the Soil, an account of nitrogen fixation in the soil by bacteria, and of the production of auximones in bacterized peat, by Gordon D. Knox, with a foreword by Professor W. B. Bottomley.—Constable & Co., Ltd., London, Eng., 1916. 2s. 6d.

leaves. While nitrogen, on the other hand, constitutes four-fifths of the volume of the air, it is not in a state which permits its direct use by plants, and one of the chief problems of the agriculturist is the restoration to the soil of available nitrates exhausted by cropping. Of these nitrates, farmyard manure is the most important source, but since it is not available in sufficient quantities to meet all requirements there has arisen the world over an extensive demand for artificial fertilizers.

Natural deposits, such as those of Chili, form the chief source of commercial nitrates. Eventually the nitrogen of the atmosphere may become generally available as a result of the development of the electric furnace whereby nitric acid is produced by passing a high tension electric current through the air. Unfortunately the processes thus far applied have a very low efficiency. Though the raw material is practically free the production of fertilizers by this method is at present commercially impracticable except where extremely cheap power is available in large quantities.

Another process is employed whereby the nitrogen of the air is brought into contact with pulverized calcium carbide at a high temperature in an electric furnace producing calcium cyanamide, which can be used directly in the fertilizer industries. The cyanamide factories of the world in 1914 had an estimated capacity of 209,500 metric tons per annum. Nitrogen is also obtained from peat and coal in the form of sulphate of ammonia, and stockyard and other forms of refuse produce considerable quantities.

The sewage from towns and cities, which constitutes an important potential source of fertilizing elements, at present pollutes our streams and poisons the sources of drinking water, and as a source of nitrates for agricultural use may be disregarded. As already stated farmyard manure is by far the most important source of nitrogen, but the wasteful methods employed in preserving it greatly reduce the fertilizing elements available from this source. It has been estimated that the farm-yard manure produced in Canada has a fertilizer value of $233,000,000 per annum (Conservation, July, 1915), from one-third to one-half of which is lost through lack of care in its preservation. This is one of the most flagrant instances of waste on a large scale in this country, and one of the most serious in its resultant losses.

Nitrifying Soil Bacteria.

Late in the last century the epoch-making discovery was made that living organisms in the soil extract nitrogen from the ground air and convert it into products assimilable by the roots of plants, and that the presence of these bacteria is essential to plant growth. Without the activity of the soil bacteria it would be useless for the farmer to manure his crops, or to attempt to enrich the soil by ploughing under green crops. The discovery, therefore, of a means of supplying or increasing these nitrifying bacteria in the soil opens up new

potentialities in the way of furnishing the nitrogen necessary for plant growth.

Apart from its mechanical effects, and from the phosphates and potash which it contains, the essential value to the land of farm-yard manure is that it possesses carbon compounds in assimilable form to act as a food supply for the nitrifying bacteria, and that it contains a large supply of the nitrogenous food material essential for plant nourishment. The numbers and productiveness of these soil bacteria are almost inconceivable. In an ounce of rich soil there may be as many as 150,000,000 bacteria, while in ground polluted with sewage the number may reach 3,000,000,000. One single specimen, reproducing by division every half-hour, would in the course of a day and a night become the progenitor of 280,000,000,000,000.

From the earliest days of agriculture the fertilizing effect on the soil of growing leguminous crops has been observed. In 1886 Hellriegel and Wilfarth discovered that leguminous plants had apparently the power of obtaining nitrogenous food material from the air because of the bacteria harboured in their roots.

Two years later Beyerinck succeeded in isolating the organism which had the power of fixing nitrogen, and in 1890 Prazmowski obtained luxurious growth of bean plants by simply watering them with a liquid culture of the bacteria. Prof. Nobbe collected bacteria from the nodules adhering to the roots of legumes, planted them in bottles containing nutrient gelatine, and put them on the market as a fertilizer under the trade name of Nitragin. Failures were numerous, and were soon traced to the deterioration of vitality of the bacteria due to the unsuitability of the gelatine medium in which they were contained.

The United States Department of Agriculture in 1903 and 1904 sent out to farmers for trial over 12,000 packages of bacteria dried on cotton wool. About three-quarters of the trials were successful, and a large percentage of the failures were attributable to the fact that the bacteria retained vitality for only six weeks to two months, while some of the cultures had been kept six or eight months before being applied to the soil. Even at this stage, however, notable results were obtained in England and the United States. In Scotland, an acre of inoculated beans yielded 3,070 lbs., against 1,800 lbs. from an acre untreated, a gain of 70 per cent. In Leicestershire, a half-acre plot of inoculated peas yielded 108 stones (1512 lbs.,) as against 66 stones (924 lbs.) from a similar area untreated, a gain of nearly 65 per cent.

Peat as a Carrier for Bacteria.

Up to this point the chief cause of failure was the lack of a suitable medium to carry the bacteria. Prof. W. B. Bottomley, in the Botanical Laboratories of King's College, London, found that when they were mixed with earth and the whole dried, the bacteria retained vitality for several months, in some instances as long as three years. In 1906 and 1907 over a thousand samples were distributed in Great Britain, and increased crops resulted in over 80 per cent of the trials.

The problem then became to supply a medium to carry the bacteria which would be widely distributed, plentiful, cheap, and favourable to retention of their vitality. Peat suggested itself to Prof. Bottomley as meeting the required conditions. In its raw state, however, peat contains practically no soluble humus, and when put on the land in this state undergoes decomposition very slowly. When exposed for a considerable period, carbon dioxide and ammonia are freely formed as a result of the action of aerobic bacteria, and the peat slowly loses its acid character, soluble humus accumulating in the form of ammonium humate.

The results of accelerating this natural process by bacterial treatment in the laboratory were startling and unexpected. Peat exposed to bacterial action for a short time under favourable conditions was found to be rich in soluble humates, to yield, in fact, fifty to eighty times as much as contained in a corresponding weight of the best stable manure.

From one-fifth to a quarter of the peat thus treated is converted into soluble plant food. All that is necessary to effect the change is to keep the treated peat moistened at a temperature of 79° Fahr. for a week or ten days.

By passing steam through the mass thus prepared a sterile medium is obtained, neutral or slightly alkaline, which is then inoculated with the nitrogen-fixing bacteria. After these have multiplied and impregnated the mass, a process requiring only a few days, the material is dried and bagged ready for direct application to the soil or for use in liquid solution as may be desired. To the finished product thus produced the name "Humogen" has been applied.

Properties of Humogen.

The properties and characteristics of the new fertilizer may be briefly summarized as follows, according to the claims put forth for it:—

1. It is an entirely organic material (humus), a large proportion of which is ammonium humate.

2. One ton of bacterized peat contains as much available plant food as fifty to eighty tons of stable manure.

3. An ideal and complete liquid manure is made by steeping it in water. So efficient is this liquid that plants will actually grow in it.

4. It is free from weed seeds, disease spores and insect pests, and is clean and pleasant to handle.

5. It directly introduces into the soil the nitrogen-fixing organisms which promote the growth of plants, and provides the food necessary for their rapid multiplication in the soil.

6. Its action is not limited to the season of application, but owing to the continuous bacterial action, the soil is made more fertile without subsequent dressing.

7. During the bacterial decomposition of the peat comparatively large quantities of "accessory food bodies" are liberated. These bodies enable the

plant to utilize the food in the soil by stimulating the natural growth activities.

8. As the growth-promoting organisms which it contains retain their vitality for some months it can be handled commercially without any serious deterioration.

9. The process of production is simple, and it can be produced at moderate cost.

10. Supplies of raw material for its manufacture are widely distributed, readily available, cheap and practically inexhaustible.

11. It is very simply applied direct to the soil—may be spread on the surface and ploughed lightly under, used as a top dressing, or applied in liquid form by adding water.

12. It makes available the insoluble potash and phosphates of the soil by converting them into humates.

13. It has a specially marked effect in promoting root growth. Plants grown with its aid are stronger, larger, more productive, and flower and fruit earlier than untreated plants, or those on which artificial manures or dung only are used. Their greater vigour is shown by more intense coloring of foliage and flowers, and by increased resistance to frost.

Results of the Use of Humogen.

Experiments with bacterized peat carried on during the past three years at Kew Gardens under the direction of the Curator, and by prominent horticulturists, gardeners and others have given some remarkable results. A summary of the results of many of such practical tests appears in a book, "The Spirit of the Soil" by Gordon D. Knox, recently issued by Constable & Co., London, Eng., and devoted entirely to the subject under consideration. Following are a few excerpts from the publication mentioned:—

> APPLES. Increased vigour of growth followed treatment. The wood was stronger and riper. The foliage was a rich dark green. There was an average gain of 1½ ounces on each fruit, and the fruit ripened about a fortnight earlier than on untreated trees. In the second year there was no further application of the treated peat, but the trees showed a robust health, and were more heavily laden than usual with fruit. The experiments were tried with the Blenheim Orange and Cox's Orange Pippin.
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> BEETS. This root responds quite exceptionally well to humogen treatment. A gain of 50 per cent. over other fertilizers has been the rule rather than the exception. The quality of the beet has been found to be greatly improved. The roots, although much larger, were excellent in colour and flavor, woolliness being conspicuous by its absence.
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> CABBAGES. Growth was earlier and sturdier. The plants showed a rich bluey green, denoting perfect health. The heads were larger, harder, and crisper than in untreated plants. They were ready for market earlier.
>
> CELERY. The sticks of treated celery were 20 per cent. larger than those untreated, and were hard and nutty. They were pulled three weeks earlier, and the crop was altogether much heavier. Owing to the

increased vigour and hardier nature of the plants, they were much less affected than the untreated plants by early frosts.

CUCUMBERS. Twenty days after planting the cucumbers which had been peat-treated, cutting commenced, 72 cucumbers, weighing 73 lbs. being cut from 18 plants before the untreated plants yielded a fruit (June 7). A fortnight later 119 cucumbers weighing 119 lbs. had been cut from the treated, as against 58 cucumbers weighing 51 lbs., from an equal number of untreated plants. The fruits were heavier; the foliage was slightly smaller, but of a much deeper green. The root action was very vigorous, top-dressings being required much more often than for the untreated plants.

GRASS. On golf-greens and lawns humogen has been tried against a mixture of malt culms, soot, and ammonium sulphate, and in every way the peat has proved superior. The grass becomes a beautiful dark green, the clover in it is thickened, and a much better bottom is developed.

LETTUCE. A series of experiments carried out in a dry spring showed a superiority of the peat over dung of 123 per cent., and of the peat over artificial manures of 176 per cent.

MARROWS (Bush). When marrows were treated with artificial manures the average weight of the fruits obtained per plant was 16 lbs. 5 oz. When treated with peat the fruits weighed 37 lbs. 11 oz. The plants fruited a week earlier, and continued bearing after the others.

ONIONS. In one experiment treatment with the peat was followed by an increase of 41 per cent. In another experiment, when no manure was used as a control, the treated plants showed an increase of 110 per cent., and where dung was used as a control, of 46 per cent. The plants grown in soil mixed with humogen, as compared with those that had received dung, had much smaller tops, the necks were thinner, and the bulbs harder and bigger, and they proved better keepers.

POTATOES. Compared with no manure, artificial manures and dung, peat has given an increase over no manure of 123 per cent., over artificial manures of 75 per cent., and over dung of 41 per cent. These results were obtained in a light sandy loam in 1913, the land not having been previously cultivated for nine years. In 1914 the same ground treated with peat gave an increase of 59.5 per cent. over land not manured. A part of each of the plots manured in 1913 was left unmanured in 1914. The land which had received artificial manures showed an increase of 27 per cent. over the unmanured land, that which had received dung showed showed an increase of 37.7 per cent., while the peat-treated land showed an increase of 83.3 per cent. The treated peat appeared to leave the land as fertile the second year as in the season of application.

ROSES. Excellent results have been obtained with roses. The plants increased in vigour, and the healthiness of the foliage and the colour of the blooms were intensified. So well marked is the latter quality that two beds of Dean Hole, one of which was treated with the peat and the other untreated, appeared as if stocked with two distinct varieties of roses. The grower has secured five first prizes in open competition this year. In one case the better colour was the deciding factor between first and second prizes.

SWEET PEAS. Marked effect. There is increase in growth, height, and length of flower-stems, and intensification in the colour and veining of the bloom. The foliage is healthier looking and deeper in tint. The Bide Challenge Cup was won this year (1915) by an amateur at the National Sweet Pea Society Show by blooms from plants grown with the aid of humogen. The second prize was also won by a grower who had used humogen. The first prize winner has won at different shows this year five first prizes and one second prize, in every case with humogen treated plants.

Since the beginning of the war there has been much public interest in Great Britain in Prof. Bottomley's discovery, and a national committee, of which the Royal Botanic Society forms the nucleus, has been formed to assist in making the benefits nation-wide. Prof. Bottomley, who in 1914 refused German agriculturists information as to his processes, has agreed to forego all rights and patents in Great Britain during the period of the war in order that the production of food-stuffs by means of the new fertilizer may be increased as rapidly as possible. An initial plant was some time ago turning out ten tons a week of prepared humogen, and there is an active demand for all that can be produced at the present time. Already improved plant has been devised for cheapening the preparation, and the probabilities are that before long bacterized peat will be available in large quantities, when the experiments can be extended to field crops generally.

The good farming referred to by Dr. Robertson in the quotation heading this article undoubtedly includes an intelligent use of fertilizers. Canadian farmers will be interested in a fertilizer of which the discoverer says that "within a reasonable time the material will double the food supply of the country." The discovery of the valuable fertilizing properties of bacterized peat is of special interest to Canada, and particularly to the older Provinces, where extensive peat bogs occur in the immediate neighborhood of farm lands which have been a long time under cultivation. Ten bogs already examined in the Province of Ontario are estimated to be capable of producing nearly 50,000,000 tons of peat fuel. If any large quantity of this peat can be converted instead into a fertilizer worth $30 to $40 a ton the economic gain to the country will be highly important, in addition to the direct advantages to be derived by the cultivators of the soil.

THE VALUE OF HUMUS IN SOILS.

PROF. H. C. THOMPSON.

(Journal of the American Peat Society.)

The crop producing power of the soils of the United States has been greatly reduced during recent years through the exhaustion of the humus content of these soils. When our American soils were first cultivated they contained large quantities of organic matter, commonly referred to as humus, but the cropping methods followed by the American farmer have been very exhaustive of this soil property.

The members of this Association have, during the past, been in the habit of considering the vast beds of peat, or humus soils found in the north and northeastern states and in Canada, from a standpoint of commercial and manufacturing uses. It is only within the past few years that those holding an interest in these vast deposits have begun to realize their agricultural value and true nature.

In order that we may get a little more definite idea of their agricultural value, it might be well for us to consider briefly the part played by humus or organic matter in farm lands, and some of the methods by which this organic matter may be obtained.

As already suggested, the virgin soils of America were rich in organic matter. The greater portion of the land was covered with forests. The enormous amount of vegetable matter, or humus, in the soil furnished it with an abundant capacity to absorb and retain moisture, thus preventing the erosion of the land and the quick drainage of the ater. In this way floods were prevented, the springs and streams had a uniform, steady flow, and the land was free from the disasters of flood that have recently befallen it. Even in the swamp areas, where great beds of peat, or humus, soils abound, drainage has been provided, and the water now runs off quickly, adding to the conditions that bring about floods along the river valleys.

The problem that confronts the American farmer today is how to replace in his soil the wasted organic matter. In this connection the great muck beds of the north and northeast are wonderful sources of wealth, especially as regards the restoration of the organic matter in the soils of the neighborhoods where they exist. Chemical analysis and crop tests have shown these muck soils to be extremely rich in nitrogen for worn out land. Based on commercial fertilizer values, many of the peat deposits are worth in the neighborhood of $6.00 to $8.00 a ton for their nitrogen alone. About $100,000,000 are spent annually by the southern or cotton states for fertilizers, the greater portion of which contain no larger percentage of nitrogen than the best peat soils· This will give some idea of the enormous value of peat or muck for use on lands within reasonable shipping distance of the deposits.

The farmer has recourse to other methods of restoring the organic matter in his soil. First, by means of leguminous crops, these, as a rule, to be preceded by applications of lime and the proper bacterial inoculation. Among the crops most commonly used for this purpose are red clover, white clover, Swedish or alsike clover, sweet clover, or Melilotus, alfalfa, cowpeas, soy beans, and a wide range of this class of plants. In addition to supplying actual organic matter to the soil, the legumes have the power of drawing the nitrogen from the air and storing it in the soil, thus serving a double purpose. Both nitrogen and organic matter are, however, abundantly present in the muck or peat soils, and for this reason they are valuable as a soil builder. When clovers and other legumes are used for adding organic matter to the land, this material is in the raw state, and must go through a period of decomposition before it is available for plant food; whereas the peat or muck, drawn from the beds and applied to the land, is in available form, except in cases where it is in an acid condition for want of exposure to the air or the addition of lime.

The addition of organic matter to farm lands not only adds plant food and increases their crop producing power, but also makes the land more receptive and retentive of moisture; in other words, a soil that is lacking in humus dries out quickly, whereas the soil that is filled with organic matter absorbs the water as it falls, and retains it for a much longer period, in this way keeping the plants supplied with the necessary amount of moisture.

Very few persons appreciate the value of peat or muck for use in preparing or treating soils for special purposes. I refer especially to the matter of green house and intensive gardening soils. In 1888 the Ohio Experiment Station, then located at Columbus, Ohio, began the use of muck soil in their vegetable forcing houses, and it was soon apparent that this soil was far superior to the ordinary sod, loam and manure mixture ordinarily used, although the peat soil was found to be lacking in potash and phosphoric acid. Since that time the use of muck soils for greenhouse work has grown in popularity, and this material is now used as a mixture with other soils by a large number of gardeners. There are many greenhouse men, however, who have not learned the true value of muck for use in their greenhouses, and there is need for a campaign of advertizing to promote the use of this material by greenhouse men. The gardeners of France and England have built up their soils by the excessive use of decayed stable manure, and in so doing have obtained practically the same results as we can secure by the application of peat or muck, especially where used in conjunction with the manure. The time is rapidly coming when every available ton of muck soil in this country will be in demand for soil building, for restoring worn out soils of the northeastern states to their original crop producing capacity, and also for supplying a suitable soil for use in connection with the enormous acreage of glass now being devoted to the production of winter crops in the north. The use of this material for fuel and manufacturing purposes is an unquestionable waste, and should be stopped, and it is within the province of this Association to so mould public opinion and educate the people to a proper and economic use of so great a natural resource.

The value of peat soils for the production of celery, lettuce, and similar crops, has been underestimated by most people. That greater results have not been obtained has been due to a lack of understanding of the nature and requirements of muck soils. Owing to the fact that these soils have in many instances been either under water, or saturated for years, they are deficient in the bacterial life required to transform plant food from the non-available to the available form. The application of manure to peat soils greatly benefits them from the standpoint of adding bacterial life. These bacteria will not thrive under conditions where the air is excluded by the presence of an excess of water in the soil, and drainage is just as essential as fertility. These same conditions cause muck soils to contain an excess of acid, this requiring correction both by aeration and the application of lime.

While muck soils are, as a rule, well supplied with nitrogen they are frequently deficient in potash and phosphoric acid, and these must be supplied from an outside source. Many gardeners have an idea that because the muck soils are black they are necessarily rich, and do not need the application of manure and mineral fertilizers. The writer has thus far failed to observe a muck soil that has not been benefited by the application of liberal quantities of both organic and mineral manures. There are indeed great possibilities for crop production on the muck soils of America, and a duty devolves upon us to promote the conservation of every acre of these soils.

THE CARE AND CULTIVATION OF MUCK FARMS

By Paul H. Todd, Kalamazoo, Mich.

(Reprinted from the Journal of the American Peat Society.)

Peat lands, which, till within a few years, have been chiefly ignored for farming purposes, are now known to be the most profitable agricultural lands that we have. They are the richest, the easiest to cultivate, and the best supplied with water, an abundance of water having been necessary for their formation.

A discussion of the best methods for operating a muck farm should probably begin with the clearing and drainage of the land. Of these two preliminary operations, the digging of the main drainage canal is first in importance, as it facilitates the clearing. This canal should be capable of carrying away all the excess water as fast as it accumulates over the farm and is conveyed to the canal by the small ditches. Otherwise the water will stand on the growing crops in unusually wet seasons, and quickly destroy them.

The clearing away of the timber and undergrowth, if it is strongly rooted, is by far the most expensive item in opening up a tract of muck, but as it has to be done only once, it should be done with an eye to the future, and the use of exceedingly destructive clearing fires should be avoided as much as possible, as they are liable to get beyond control and burn off 1 to 3 feet of the soil. The use of dynamite under stumps, and teams and engines for pulling them out, will be a good investment in the long run, for though the burning method is cheaper and quicker at the time, the loss of the top layers of muck is of much more consequence than the increase in expense when clearing without fires that burn the ground. The brush should be cut and piled, and the stumps and logs also piled, and burned when the ground is sufficiently wet so that the fires will not work down into it. Because of the lightness in weight of the muck soils, causing a certain quantity to blow away every spring before the vegetation is high enough to hold them during the high winds, and also because of the apparent oxidation of certain constituents of the soil during each year's cultivation, by the com-

bined action of the sun and air, the thickness of a layer of muck under cultivation seems to steadily decrease, frequently at the rate of an inch or two per year. This being the case, the loss from bad fires would be very serious, where the muck layer is only a few feet in thickness.

After providing the main canal, the purpose of which is to carry the surplus water off the farm, smaller drains should be dug parallel to the main canal and emptying into a single lateral at the lower end of the farm. This arrangement will permit the working of the farm in long fields, doing away with much of the turning necessary where the farm is cut up by many ditches running at right angles. Also, if the buildings are near the center of the farm, as they should be for the greatest saving in time in reaching the different fields, any one of the long fields may be reached in the minimum time from the buildings, and the team or machine started to work from the main road, with the least loss of time. This arrangement also makes it possible to dyke the main canal in through the entire length of the farm and in some cases thus avoid disastrous flooding. Where the land is not tile drained, it is well to have the small drains an eighth of a mile apart, tile or small culverts being placed in them at intervals of a half a mile to make crossings for teams. The small drains should be about 3 feet deep, and just wide enough so that they can be kept clear of obstructions and clean.

Tile draining in muck land appears to be very beneficial, but as the expense is considerable it is usually placed at first only in the ground that is especially cold and wet. The usual method is to lay 4-inch common drain tile in parallel lines about 5 or 6 rods apart, at a depth of 3 or 4 feet below the surface. Such tile cost about $18 per 1,000 linear feet, freight paid, in Michigan. About four hundred and fifty linear feet of tile per acre drained will be required, so that the cost is about $8 per acre for the tile. The trench for the tile must be dug to grade and have an outlet lower than the grade. The digging usually costs 15 to 25 cents per rod, or $4 to $7 per acre. The outlet is usually an open drain, which should be cleaned once a year, the ends of the tile drains being cleaned out at the same time. If a machine is used for digging the trench it should have a sighting and depth-regulating equipment, making digging to grade an easy matter. If the work is done by hand, however it will be necessary to back the water up to the level of the tile and obtain the grade from the level of the water, or else to use a surveyor's level.

Last in importance in fitting out a muck farm are the buildings, as temporary, rough shelters will do at the beginning. Buildings should be as near the center of the farm as possible, and though they should be built as cheaply and economically as possible for fulfilling their special requirements, they should provide warm and dry shelter for the horses and other stock, protection for the tools and machines from snow, rain and sun, and comfortable and decent shelter for the employees. The first two are indispensable for the economical operation

and maintenance of the farm, and the comfortable and neat-appearing houses will prove a good investment in insuring an easier labor supply and bringing a better class of help to the farm.

As early as possible in the development of a muck farm, it is highly advisable to lay out a series of windbrakes at intervals of a quarter of a mile, parallel to the ditches, and far enough away from ditches so that they will not interfere with keeping the ditches clean and so that the dirt thrown up will not be piled against the trees. There should also be windbreaks set out at right angles to these at the upper and lower end of the farm, and along the main road. These windbreaks may be made with a single row of trees planted about 6 feet apart in the row. They should be evergreen trees so that they will have their foliage in the spring when it is needed most. The white cedar or arbor vitae seems to be the most suitable evergreen, and the elm the most suitable deciduous tree. In the course of years these will be become very valuable for preventing the blowing of the soil and the flattening of crops under heavy winds.

Though the profits from the different crops vary greatly, depending on the gross returns and total labor expense, and cost of materials, as fertilizer, seed, etc., there are a few chief operations that are common to all crops. In general the ground is plowed once every time it is planted. This should be the rule, though slack farmers sometimes plant without plowing. Marcus Cato, the famous Roman, wrote a classical treatise on farming and said that the most important thing after plowing was to plow again, and he was much nearer right than the farmers that slight their plowing. It is very desirable that the plowing be done in the fall rather than in the spring, as the spring-plowed muck soil has a tendency to bake, on account of the numerous fibers it contains, held together by the gluey humus. When plowed in the fall, however, the winter frosts thoroughly disintegrate this fibrous mass and pulverize it. The exposure during the winter and spring also aerates and ventilates it, overcoming a sourness and rawness which is liable to be prevalent in the spring-plowed ground.

The plowing should be 8 or 10 inches deep for truck crops or most other crops, as the plowing depth determines the depth to which the soil will be capable of feeding the roots. After the plowing and before the spring planting, the soil should always be thoroughly worked up with disking harrows or toothed harrows, in order to give it additional ventilation and to check any weed growth that may be starting. The chief importance of this harrowing and of subsequent cultivation is due to the necessity that the plant roots be able to breathe pure air, which has to be worked into the soil in this manner. During the course of the harrowing, between the plowing and the planting, is usually the time for the first application of fertilizer, which may be followed later with one or more further applications. Chemical fertilizers are usually sown broadcast with special drills, of which there are a number of different makes on the market, some much better than others.

Of all the important principles of modern agriculture, fertilizing seems to be one of the least appreciated by American farmers in general. It is largely because of their more extensive use of chemical fertilizers that European farmers get so much larger yields than we do. To a certain extent the continual dissolution of the rock particles in the soil replenishes the chemical fertility of some soils, as the fertility is reduced by the crops that are removed and sold. This is not true of muck soils, however, as they are all organic matter and there is no rock going into solution in them. Therefore the best system for the fertilization of muck soil is to each year put back into the ground the same quantities of the essential elements of plant food that are removed. In this way you will retain the original fertility in your soil, which is well worth the cost. The thought may come to some that, though such a method might do now, while the world is well stocked with mineral fertilizers, nitrate beds in Chili, and potash mines in Europe, and an abundance of phosphate rock all over the world, the problem of maintaining soil fertility will become difficult after these mines have been exhausted.

As a matter of fact, however, all danger of a nitrate famine is being removed by the exceedingly rapid development and extension of the electrochemical process of nitrate manufacture, in which cheap and abundant electric-power supplies, such as exist in Scandinavia and many other parts of the world, are used to burn nitrogen in air under the heat of the electric arc, nitrate being the final product, the cost of manufacture being well below the market price of Chili nitrate. As to potash, there have been new deposits of seemingly exhaustless extent discovered in Alsace-Lorraine, but even assuming that all the potash mines in the world will one day be exhausted, we have in this country, or rather along the Pacific Coast, a source of potash sufficient to afford us a continual supply at a cost below the price prevailing before the war, the present market price being prohibitive for agricultural use. This great and important source is in the great kelp beds. Kelp is a seaweed which secures itself to rocks or shore and grows in dense masses several feet in depth and sometimes several miles in width, extending up and down the coast in various places.

Though the utilization of it for potash is scarcely more than experimental as yet, as the potash famine in this country is only about a year old, the method of utilizing it is as follows: A large floating mowing machine cutting a horizontal strip about 10 or 12 feet wide, about 3 feet under the water, and with vertical knives on each side, the horizontal cutters being power driven, is hauled along by a tug equipped with knife-edged propellers, which do not tangle in the seaweed. In the body of the cutting machine is an endless belt which carries the cut kelp to a barge in the rear, capable of holding 30 to 50 tons of the wet kelp. The load is then towed to the manufacturing plant, where the kelp is first put through a press to squeeze out the excess water; then cut into pieces and run through a

cylindrical drier, from which it issues thoroughly dried. It is then put into large retorts and charred at a certain definite temperature, creasote being a by-product of this stage. The charred kelp is then leached and the resultant solution concentrated by evaporation and crystallized, the potash obtained amounting to about 25 per cent. of the weight of the charred kelp. Iodine is a by-product of the process, its separation costing 16 cents per pound, the market price being about $5 per pound. When cut off in this way, the kelp renews itself completely in three months, so that it affords a continual means of supplying our entire requirements in potash from that inexhaustible and everlasting source, the sea.

Books on agricultural chemistry and bulletins of the United States Department of Agriculture and of the agricultural college experiment stations, as well as printed matter issued by fertilizer manufacturers and jobbers, state the amount of the essential plant food that is removed by the different crops. Sugar beets, for instance, at a yield of 15 to 20 tons per acre, remove as much potassium from an acre of ground as is contained in 225 to 300 pounds of muriate of potash, worth from $4.50 to $6 at prices current before the war started. A ton of sugar beets in Michigan is worth $6, so that a farmer raising 20 tons per acre should figure to put one ton per acre back into the soil in the form of muriate or sulphate of potash. It is better to put back a little more than the theoretical amount, in order to make up for the losses from the leaching of the soil.

The three most essential elements of plant food are nitrogen, potash, and phosphoric acid. The first is obtained chiefly in the form of Chili saltpetre, but is comparatively abundant in muck land, having been deposited in the soil through many centuries by many different kinds of leguminous plants growing in it and eventually becoming a part of it. This usually costs between $50 and $60 per ton. In muck farming it is used chiefly for producing rapid growth and forcing growth through bad periods, as table vegetables generally have to grow continuously in order to have a mild flavor. As nitrate of soda is immediately absorbed by the plant, it is often sprayed onto the soil at intervals of two weeks or a month.

Phosphoric acid is supplied commercially from rock phosphate and from dissolved bone. The latter contains more phosphoric acid in available form, but the rock lasts through a greater period of years, as the soil acids continually dissolve it and so render it available. In buying a phosphate fertilizer you should be sure that there is as large a percentage of available phosphoric acid in it as you are paying for. The form of potash chiefly used is the muriate, but the sulphate, which costs about the same, improves the flavor of some crops, and is preferred for sugar beets on account of the chemical effects of the chlorine of the muriate during the process of sugar manufacture. The soil should also be kept well supplied with lime in the form of ground limestone or marl, as a cer-

tain amount of this is necessary to correct acidity. Where marl beds underlie the muck, liming may not be necessary, but the best method of determining whether it is needed is to sow from one-half ton to a ton per acre over a few acres and compare the results with those where lime is not applied. Limestone or marl can usually be purchased at 50 cents to $1.50 per ton at the deposits or grinding mills, and is generally applied liberally, when used, so that the application will last through three or four years.

After the completion of the fertilizing and subsequent harrowing, the ground is ready for planting, being well drained, and yet well stocked with moisture, well fertilized, well pulverized so that the rootlets can easily make their way through it, and well aired and ventilated so that the rootlets can breathe plenty of pure air in the course of their development.

Relative to the choice of crops for any particular piece of ground, there is one very important consideration that cannot be overlooked without expensive loss of time, labor, and material. This is, that the same land must not be in the same crop all the time, but that the farm must be operated under a definite system of crop rotation, flexible, perhaps, but systematic. Whether onions, or celery, or sugar beets, or cabbage, or all, or none be the specialty, there must be a certain fraction of the farm in other crops than any single specialty, each year, so that within a certain period of years, say three to five years, according to the special circumstances, every portion of the farm will have spent one or two years in other crops than the specialty. Where this principle is neglected for any long period of years, the inferiority of the product in spite of lavish fertilizing and cultivation, and the prevalence of soil diseases and pests, will clearly prove its importance. In order to conduct this rotation in as systematic a manner as possible, it is a very good plan to make a rough sketch map of the farm, making several carbon impressions, and using one map for each year for several years in advance, make a general scheme for the rotation of the crops, subject each year of course, to choice among a few crops for any particular piece of ground, but so planned that two crops subject to the same diseases, and breeding the same pests, will not be planted on the same ground more than two years in succession. Relative to the choice of truck crops for any particular year, it has seemed to be the rule that the most profitable year for a crop that is subject to large market fluctuations and is easy to go into and to discontinue, as onions or potatoes, is the year following a season of discouragingly low price. There is an old rule among farmers that the best year to plant potatoes is the year when the seed potatoes are given away. After such a year growers seem to be generally discouraged and plant lightly, whereas, after a year of good price, the temptation to plant heavily is too great to be resisted by a large majority of growers; hence the resulting crop is excessively large, and the profits are correspondingly small.

Relative to the particular methods for raising the various important muck crops, the first of the crops to be planted in the spring is the onion. This should

be planted as early as the ground can be fitted. The ground should be plowed deep the preceding fall, and disked and harrowed as soon as the frost is out in the spring, being fertilized at the same time. After the coarse harrowing it is harrowed with a fine-toothed, comb-like harrow, which picks up all the brush and sticks that if left, would interfere with the planting and cultivation. It is then floated with a light wooden float, the horses wearing broad wooden shoes called muck shoes, clamped on over the hoofs so that they will not punch holes in the ground, into which the planting drill might drop, causing irregularity in the planting. The seed is then sown with a hand drill at the rate of $3\frac{3}{4}$ to 5 pounds per acre, in rows 12 to 14 inches apart. If a fairly large acreage is to be planted, needing several planters, they usually work across the field in a diagonal line. Onion seed costs usually about $1.25 to $1.50 per pound, and it is very important to know that it has been properly grown from select bulbs, as inferior onion seed is liable to produce a large proportion of thick necked and bad shaped onions. The thick necked onions are called scullions and do not keep well. As soon as the crop is started it should be cultivated with a hand cultivator, and weeded by hand, and thereafter cultivated at least once a week and weeded as often as the weeds become numerous, which will depend on the thoroughness of the previous eradication of weeds on the land. In the early fall when the tops have died down, the onions are pulled and laid in rows on the top of the ground, and after being left exposed for a day or two, the dried tops are sheared off a half inch above the bulb and the onions are put in crates and the crates piled up in the field, the lower ones standing on some rough boards, to give ventilation, or put under cover. If left outdoors they should be covered with canvas during rain. Just before being put into crates the onions are generally sorted by being worked over on a screening table having bars at a distance apart corresponding to the diameter of the smallest normal onion. This removes the most of the smaller onions as well as the dirt and litter. Before the freezing weather comes on, the onions must be either sold or placed in covered storage.

The cultivation of celery on a large scale is carried on chiefly for the production of late celery, as early celery must be moved quickly and its handling involves a great amount of detail. For late celery the seed is sown early in the spring in open beds by scattering it over the surface and lightly raking it in. One ounce of seed will make a narrow bed about 200 feet long, or enough plants for $\frac{1}{4}$ to $\frac{1}{2}$ acre. As soon as the plants are big enough, usually beginning about the middle of June, they are set out in rows $4\frac{1}{2}$ to 5 feet apart, and about 6 inches apart in the row. Frequent cultivation should be given throughout the growing season. As soon as the ground is thoroughly cooled in the fall, which is usually in the latter part of September, the dirt between the rows is banked up against the stalks with a horse-drawn implement called a banker. The celery is banked three times at intervals of about 10 days or two weeks, the height of the banks being increased each time, until at the end of the last banking it is up to

the lower part of the foliage. Within about three weeks of the last banking the celery will be bleached ready for shipment. The statement made above about the importance of steady growth is particularly true of celery, and if the season is cold and backward, the ground should be sprayed with nitrate to force the growth, so that it will be mild and tender. Celery is usually shipped in the rough, without washing, as it keeps better that way, the dead or unbleached stalks on the outside being off in the field as it is harvested. It is usually shipped in crates about 22 inches square, of a height corresponding to the height of the stalks, usually 18 or 20 inches. When made 22 inches square they may be set four wide in an ordinary refrigerator car. The crates are made from cheap lumber, three slats on a side and three on the bottom. The two upper slats on one side are left loose at one end and not nailed until the celery has been put in. The crates are placed upright in the refrigerator car in tiers, ventilating space being left around the sides of the car. If the celery cannot all be shipped when ripe it is placed upright in trenches about a yard wide, high enough so that it will be well drained, and the earth banked up around the sides of the trench, level with the tops. In this shape it will endure a considerable amount of cold weather.

Cabbage is also a transplanted crop, the seeds being sown about the first of June, with a hand drill, in rows about 10 inches apart, the drill being so regulated as to space the seeds about an inch apart in the row. It will take about 2 ounces of seed to supply enough plants for one acre of cabbage. When the seedlings are three or four weeks old, or three or four inches in height, they are transplanted in rows three feet apart, and placed 18 inches to 2 feet apart in the row. There are two varieties in extensive cultivation, the Danish Ball Head, preferred for winter storage, and the Domestic, preferred for the manufacture of sauerkraut, which has been made quite an industry in cabbage growing districts. Muck ground is excellent for cabbage, and as a rotation crop cabbage is excellent for muck ground.

The various mints are grown almost exclusively on muck land. Though this crop is confined to a few districts for its main production, it is nevertheless important as a muck crop. The mint plants are propagated entirely from runners being laid in a continuous string in trenches 3 feet apart. This is done as early as possible in the spring, and the usual weeding and cultivation given later. The plants are cut when in blossom and the oil distilled off, the straw being dried for cattle feed, or composted and put back onto the soil.

Sugar beets grow very heavily on muck land, though with a smaller percentage of sugar than on high land. They are a profitable crop, however, for localities near the factories, or with good shipping facilities, and are good for the land, as they send tap roots deep into the ground, which leave channels when they decay, allowing the water to drain away more readily in wet weather and drawing it up in dry weather. They should be planted about the 5th to the

15th of May in districts where corn is planted about the 15th, or, in general, about ten days before corn-planting time. Twenty-four inches is a good distance apart for the rows. Sugar beets are not transplanted, like celery and cabbage, but are sown thick in the permanent rows and thinned out to about 8 inches apart when the second pair of leaves appears, or as soon after that as possible. About 15 pounds of seed per acre is necessary for a good stand. It is well to let out on contract all the hand labor, the usual rate being about $18 per acre.

Of intensive farming in general, it may be said that there is probably no business which requires more thoroughness in preparation and providing ways and means in advance, as the seasons are uncertain at best and with no man's convenience. It is well to not only have a definite scheme for the planting before the year's work opens up, but to see that seed, fertilizer, hand tools, horse implements, etc., are as far as possible all provided for in advance. This method requires a lot of foresight until a farm is well established and under way, but it is the only method that makes for efficiency in farming and the obtaining of satisfactory results.

*Read at the Detroit meeting, September, 1915.

THE USE OF PEAT IN COMMERCIAL FERTILIZERS.

H. E. Wiedmann.

(Journal of the American Peat Society.)

Many users of fertilizer material and a large part of the general public think that all commercial fertilizers contain a large percentage of material which has no plant food value and which has been added solely to make weight and bulk. They think that everything in a bag of fertilizer which is neither nitrogen, phosphoric acid, nor potash, consists of this inert material commonly called "filler," and that the consumer must therefore pay for a lot of worthless material to get a few pounds of food for his crops.

As a matter of fact this so-called filler is present because it was put there by nature, and is a necessary part of the chemical compounds which contain the essential plant-food elements.

Should we want to apply 100 lbs. of nitrogen to a certain amount of land we cannot supply pure nitrogen for it is a gas, and can neither be supplied to the soil or used as a food by the plants.

To overcome this, nature (and now man) combines this gaseous nitrogen with various other elements, and gives us chemical compounds in a solid form which we can use, and which the plants can assimilate.

If we consider Chili Saltpetre, or sodium nitrate, we find only a little over 16 per cent. is nitrogen, and that in order to get the 100 lbs. we want to apply

to the soil it will be necessary to use somewhat more than 607 lbs. of the solid sodium nitrate. Would it be correct to call the 507 lbs. of inert matter a "make weight" filler?

Phosphoric acid would absolutely destroy plant life if applied to the soil undiluted, and we use it as prepared by nature in combination with other elements, in the form of bone or rock phosphate.

Potassium is a metal which will float on water, and which when brought into contact with water bursts into flame with a violent explosion. Surely we cannot use this to feed plants! Nature has again provided us with compounds containing this valuable element in an easily manipulated form, such as potassium chloride and sulphate, which contain inert substances together with the potassium.

In a ton of 3-9-3 fertilizer there are 300 lbs. of plant food, yet the 1700 lbs. of salts, organic matter, etc. which are present are needed to contain these 300 lbs. of necessary material. And unless this so-called inert material were present, the concentration of the essential elements would destroy all forms of plant life. While the presence of this material is necessary no manufacturer is going to use too much of it, and therefore not give the consumer the value of his purchase price, for all sales, as you know, are based on the actual amount of plant food present as determined by analysis, and it would be suicidal for a fertilizer mixer to add so much filler that the mix becomes of no value as a fertilizer.

I think, therefore, we are safe in assuming that a diluent, filler, or carrier, by whatever term you want to call it, is necessary in a complete commercial fertilizer. The question now arises, what is the most suitable substance for this purpose?

Numerous substances have been used, most of which have had no value as a plant food, and some of which have contained material which has a deleterious effect upon the growth of plants. We will not dwell upon the various fillers at this time, but will consider for a moment the material which has been found eminently satisfactory for this purpose, i.e., peat.

The use of powdered peat as a filler permits of the use of substances in commercial fertilizers which could not be used otherwise. There are many kinds of waste matter from the packing plants which could not be used in fertilizer unless in conjunction with peat, because they are hygroscopic and absorb moisture from the air, and either cake into hard masses, or give off offensive odors thus indicating decay. When animal matter decays its nitrogenous matter, which makes it of value as a fertilizer, passes into the air as gas, and thus is lost. Peat not only prevents to a large extent such decomposition, but acts as an absorbent when decomposition does occur, and retains the valuable gases which thus pass from the animal matter into the peat and are still available for plant food when the fertilizer is applied to the soil.

The concentrated tankage, or so-called "stick," which is prepared in meat packing establishments by evaporating the water from the tanks in which the tallow and grease is cooked, has, as you know, been used for many years to increase the nitrogen content of fertilizers. This material is a dry solid powder when first prepared, but it is extremely hygroscopic and soon absorbs moisture from the air becoming very sticky and finally coalescing into one solid mass the size of which depends only on the size of the pile of stick. After a time it was found that by adding a small amount of copperas to the water before it was evaporated this action could be overcome to some extent. Recently, however, stick has been found to be a valuable material in tankage used for stock food. Copperas would be injurious if used in a food to the extent that it is used in stick, so it became necessary to find a suitable substitute. This has been found in peat. In fact peat is an improvement—for stick made with the admixture of peat remains in much better mechanical condition than when copperas is used.

The improved method of producing concentrated tankage consists in evaporating the tank-water to a suitable consistency in vacuum pans, adding about 40 per cent. peat, and then mixing with the regular tankage just before it enters the dryers. This gives a uniform product of excellent mechanical condition, and rich in ammonia. If the material is to be used in stock food it will contain nothing injurious.

Many of our large cities are utilizing the garbage for the production of grease and tankage. Garbage tankage is a very low grade of fertilizer material, not only on account of its low ammonia content, but also on account of its peculiar mechanical condition. It is so very light and fluffy that it is difficult to incorporate in a complete fertilizer. Experience has shown that if peat is added to the garbage tankage as it enters the dryers a greatly improved product is obtained in the way of its mechanical condition, and in the ease with which it is mixed with the other material. It is found also that the presence of peat in the tankage as it goes through the dryers overcomes to a large extent the burning of particles of the material in the dryers, and eliminates the resultant bad odor arising therefrom which has been the cause of much complaint and many law suits wherever garbage has been reduced.

It has been found that the use of peat in the preparation of fertilizer from fish is of advantage in that it improves the physical condition of the scrap—prevents the disagreeable odor—and reduces the danger of fire. Fish scrap contains a considerable amount of oil, and many fires are produced in the store houses on account of the oxidizing and heating action of this oil in contact with the organic matter of the fish scrap. When peat is added this oil is largely absorbed into the peat, and retained in such a manner that the chances of fire from spontaneous combustion are very materially reduced. This absorbing action also accounts for the retention and elimination of much of the "fishy" odor which is always associated with fish fertilizers. The improved physical con-

dition results from the dry pulverant action of the peat. Fish scrap which has peat mixed with it will adapt itself to mechanical mixing with other fertilizer materials much more satisfactorily than will scrap that contains no peat.

By far the most extensive use of peat as a filler is in the manufacture of finished commercial fertilizers. Its advantages in this connection are numberless.

Acid phosphate or acidulated rock has a marked tendency to cake, and is handled with extreme difficulty. This disagreeable feature is augmented when the material is used "green," or before it has had an opportunity of becoming thoroughly dry before use, a condition which often arises in a busy fertilizer plant.

When the caking action has taken place the material will not flow from the bagging machine, neither can it be used in a drill when applied to the soil. This is overcome by the use of peat.

Even if the acidulated rock is "green" the addition of peat will overcome any tendency to cake; the fertilizer may be bagged without any inconvenience, and may be easily drilled. This improvement being due to the physical nature of the peat and for the reasons hereinbefore described.

Agriculturists, after having used a fertilizer which meets their requirements, desire naturally the same grade of material in future shipments. Among other properties they note the color of the product, and many of them insist on the same color from year to year—thinking of course, that the same grade of fertilizer should always be of the same color. While we know that the efficiency of a plant food is not influenced by its color, it is nevertheless good policy to produce material of uniform appearance. Manufacturers who have used peat in their finished product find that this otherwise difficult problem of uniform color is easily solved. The peat being of a black shade neutralizes any color which may be due to other materials present, and the fertilizer as sold has always the same appearance. This, of course, is of minor importance, but it is worth bearing in mind.

One of the most important series of experiments carried out with the view of determining the suitability of peat as a fertilizer was conducted by the Agricultural Department of the State of North Carolina. In one series of tests, peat was used as the source of nitrogen, and in the other dried blood was the only nitrogen carrying ingredient. The two crops, corn and cotton, were used for the tests with the following results:

Plat No. 1 was unfertilized, and was used as a control. The yield was 670 lbs. of seed cotton.

Plat No. 2 was treated with:—

200 lbs. acid phosphate.
50 lbs. Manure salts.
350 lbs. Peat (containing 9.52 lbs. nitrogen).
Yield was 1025 lbs. of seed cotton.

Plat No. 3 was treated with:—

200 lbs. acid phosphate.
50 lbs. manure salts.
71.1 lbs. dried blood (containing 9.95 lbs. nitrogen).
Yield was 980 lbs. of seed cotton.

This indicates that the peat with 0.43 lbs. less nitrogen than contained in the blood produced 45 lbs. more seed cotton. The peat produced a gain over the untreated plat of a little over 37 lbs. of cotton per pound of nitrogen, while the dried blood produced a gain of only a little more than 31 lbs. per pound of nitrogen.

Plat No. 4 was also unfertilized, and was used as a control in the tests with corn. The yield on this plat was 11.6 bushels of shelled corn.

Plat No. 5 was treated with:—

150 lbs. acid phosphate.
35 lbs. manure salts.
150 lbs. peat (containing 4.8 lbs. nitrogen).
Yield was 22.5 bushels of shelled corn.

Plat No. 6 was treated with:—

150 lbs. acid phosphate.
35 lbs. manure salts.
64 lbs. dried blood (containing 8.96 lbs. nitrogen).
Yield was 27.6 bushels of shelled corn.

The peat used, which contained 4.16 lbs. less nitrogen than the blood, produced only 5.1 bushels less corn. The peat produced a gain over the untreated plat of 2.3 bushels of corn per pound of nitrogen, while the dried blood showed a gain of only 1.8 bushels per pound of nitrogen.

Considering these figures on a percentage basis, and a unit basis of nitrogen, we find that the gain in the yield of cotton was 55.4 per cent. where peat was used as the source of nitrogen, and 46.3 per cent. where dried blood was used. A difference of 9.1 per cent. in favor of peat.

Corn showed an increased yield of 163.7 per cent. where peat was used, and 137.9 per cent. where dried blood was used as the source of nitrogen. A difference of 25.8 per cent. to the credit of peat.

These results, which are so favorable to peat, must be regarded as authentic, for they were obtained by very careful work on the part of a State experiment station and are absolutely without bias. When these figures, together with others of equal authenticity, were presented to the various state officials, they all (even those who were at first sceptical) acknowledged the plant food value of the nitrogen content of peat, and allowed the material to be sold as a fertilizer in their respective states.

One official on receiving a copy of this report said; "As you have submitted to us satisfactory evidence of the suitability of the nitrogen in your special make of muck or dried peat, we herewith withdraw the embargo laid on it some years since, and grant you permission to sell the same within the limits of this State."

Dried blood has always been considered the best form in which to apply nitrogen to the soil for plant food, and we can hardly expect the remarkable results obtained in the tests just described to be due to the increased efficiency of the nitrogen of the peat over that contained in the blood, and we must look elsewhere for an explanation, i.e. to the humus content or organic matter of the peat, and the bacterial action in conjunction with the nitrogen content.

It is well known that the nutrition of a plant depends, not only upon the supply of mineral food elements, but also upon the presence of certain accessory organic food substances, very small amounts of which are sufficient to satisfy the needs of the plants. This subject is now being investigated in England, and among other materials they are studying the action of the humus of peat in connection with this property of supplying organic food substances. We may expect valuable information from this source later.

At your last meeting, in Duluth, Mr. H. C. Thompson presented a paper on the use of peat in growing greenhouse crops in which he described experiments which led him to the conclusion that peat is a very satisfactory and valuable material for that purpose. He says, "The indications are that a good type of muck soil can be used as a substitute for a part or all of the manure with very satisfactory results." He also says that uncultivated or raw muck soil gave much lower yields than the cultivated peat soil. This has also been found to be true in Illinois.

Part of a deposit of peat near Manito, Ill. has been in continuous cultivation since 1885, and peat from this portion of the deposit is richer in plant food and gives better yields when used as a fertilizer than similar peat which has never been under cultivation. This differenee in value is no doubt due to the improved physical condition of the soil and to the presence of beneficial bacteria.

It is the practice, therefore, at this plant to keep all of the soil under cultivation, except that portion from which the peat is being removed. After a particular field is worked over, and all the (at present) valuable material has been removed, the soil is again put under cultivation, and after a number of years by proper manipulation the surface again consists of marketable peat, well decomposed, and with a four per cent. nitrogen content on a dry basis. This indicates that the cultivation of peat land enriches its value as a plant food.

The deposit of peat to which I have referred is evidently heavily impregnated with bacterial forms of life, some of them being in such numbers that a visible effect is seen in the form of a white mould, and some of which may have, to a limited extent, the power of fixing atmospheric nitrogen. Several years ago

a fire destroyed one of the storage houses at this plant, and for two years the peat that was in storage at the time of the fire was allowed to remain in the open unprotected from the weather. This material was carefully analyzed daily as it was stored, and at the end of two years when it was sold, an analysis was again made on each carload. During this period a gain in the nitrogen content equivalent to 0.3 per cent. ammonia was noted. This occurrence conclusively refutes the statement sometimes made that peat loses in value when exposed to the weather, and it also indicates the possibility of a nitrifying action on the part of the peat bacteria.

Many manufacturers and some users of commercial fertilizers have been sceptical as to the value of peat on account of the fact that by the ordinary and well known chemical methods of determining the availability of the nitrogen in organic material only one-third to one-half of the nitrogen in peat is shown to be available. This is a false position to take, for these methods are only empirical, and the actual nature of the complicated compounds in which nitrogen exists in peat is unknown or only surmised. The only correct method of determining this availability consists in making actual growing tests and studying the yields obtained. When this is done with properly prepared peat the results are out of all proportion to what might be expected from a study of the chemical analysis for availability, and until these compounds are known and their action on plants, together with the action of the compounds formed by them during their decomposition in the soil, has been determined, the question of the availability of peat as a plant food cannot be thoroughly understood. It is a fact that until recently practically every experimenter with peat as a fertilizer began his work with the notion that peat would never take the place of other nitrogen bearing compounds. This idea being based on the results of chemical analysis which always showed a low percentage of available nitrogen. As he began to compare his yields from the plats treated with peat with plats treated with the old "stand-bys" his eyes were opened.

This work has been steadily going on and the use of peat is constantly increasing, until now many fertilizer manufacturers use it as the only source of nitrogen in many of their brands of fertilizers.

PEAT AS FOOD FOR STOCK.

The peat mull obtained by screening the peat shredded for stable litter has long been used in Europe as the basis of food for stock made by mixing it with refuse molasses, obtainable in large quantities at a low price from beet-sugar factories and cane-sugar refineries. This material makes excellent and fattening food, but is difficult to feed to stock on account of its stickiness and fluidity as well as because of its effects on the digestive organs. When mixed in proper proportions with peat powder, however, it is readily eaten by all kinds of live stock, and beef cattle, hogs, sheep and horses are reported to be greatly improved in condition and weight by its use. In England, Sweden, and Germany, thousands of tons of peat mull are used annually in the preparation of such sweetened cattle foods, but until very recently, possibly on account of the lack of an available supply of peat in the proper form, it has had very slight use in the United States. For the last few years, however, an increasing quantity of mixed stock food containing molasses has been manufactured and sold in this country, and still more recently, powdered black peat has been added to mixed cattle foods in small quantities, with reported beneficial effects.

PEAT AS FERTILIZER AND FERTILIZER FILLER.

The most successful industry based on peat so far attempted in the United States is that of preparing peat for use as a fertilizer or as a filler for chemical fertilizers. Black, thoroughly decomposed peat is most satisfactory for all fertilizer uses, as such peats are generally heavier, more compact, and contain more nitrogen and less fibrous material than the brown types.

The processes of preparing peat for such uses are comparatively simple. The bog is drained thoroughly, and the surface layers are carefully plowed and cultivated for one or more seasons before digging begins. The peat is prepared for sale by reducing it to the state of a powder containing about 10 per cent. of moisture. When an area is considered ready for gathering the peat, the surface is repeatedly harrowed either by ordinary harrows or by special machinery for the purpose of drying the surface layers as much as possible. When sufficiently dry the harrowed peat is scraped into windrows and loaded on tram cars, which, in the larger plants, are drawn to the drying plant by small locomotives operated by electricity or gasoline. The unloading is done from a trestle over the stock pile, from which the peat is elevated as needed to the inlet hoppers of large rotary cylindrical driers. The driers used are of the directly heated single-tube type—that is, they consist of a single shell of boiler iron, with a large furnace at one end and a settling chamber, from which the smokestack or chimney rises, at the other. The cylinder is slightly inclined from the inlet to the outlet

end and is revolved on its long axis by mechanical means. Iron flanges, running spirally the length of the inside of the cylinder, raise the peat to the top of the tube and drop it to the bottom through the heated air and gases, as these pass from furnace to smokestack, and at the same time move it steadily forward to the outlet, where it is automatically discharged. Usually a fan blower or an exhaust fan increases the draft through the drier, and this can be regulated to meet the requirements of the peat. After the peat has passed through the drier it is elevated by mechanical conveyers of considerable length to permit proper cooling, screened to remove coarse and lumpy material that has not been completely disintegrated in drying, and immediately shipped or stored in fireproof storage bins.

The peat that is prepared for fertilizer filler, for stock food, and for certain grades of fertilizers of which the peat powder forms the base is dried to a moisture content of about 10 per cent. When the peat is to be applied directly to the soil as a source of humus and of organic nitrogen, the drying is not carried so far. Considerable quantities of peat are prepared for such use and are sold as "sun-dried," and in that state the material may have a moisture content of 25 to 50 per cent. or even more.

Some of the peat sold during 1914 for direct use as fertilizer was enriched by the addition of mineral salts of high fertilizing value, especially compounds of potassium and phosphorus and substances furnishing organic nitrogen to supplement that present in the peat.

The production of peat for fertilizer uses during 1914 as reported was 37,729 short tons, valued at $249,899. The selling prices given varied widely according to the grade of the product, the uses to which it was to be put, the quantity and quality of materials added, and the size of the selling unit. In carload lots the price of sun-dried, untreated peat ranged from $3.50 to $6 a ton. In small lots, shipped in bags or barrels, the prices ran considerably higher. Fertilizer filler, sold at a somewhat uniform price per unit of nitrogen, varied according to the percentage of nitrogen and locality of production from $4.50 to $7.50 a short ton, the average price being $6.02. The quantity of peat sold for fertilizer filler was 22,267 tons and for fertilizer 14,962 tons.

THE USE OF PEAT IN STOCK FOODS.

JOHN WIEDMER, St. Louis.

(Before American Peat Society, at Detroit, Sept., 1915.)

Of all known uses of peat in the United States this, probably, is the least generally known. It is so new to us, and so far as I know there are very few data to refer to. To my knowledge there is no publication treating on the subject of a prepared peat for an ingredient in stock food.

An average sweetened feed without peat contains a maximum of about 20% of molasses, but with peat as high as 50% can be used.

A Missouri friend tells me that, besides his extensive cattle feeding, he also feeds many hogs; that since using peat his losses through disease have almost totally disappeared; that often when he buys stock hogs and puts them on his feed he notices that they discharge worms, and the hogs that look runty and rough soon develop and become smooth. His cattle also have nice smooth coats and a fine healthy appearance, for which reason they always command the top prices in the stock markets at Kansas City.

A Texas friend also imports from northern states young stock for breeding purposes. Before using peat such stock was vaccinated or inoculated and treated by veterinaries, as his losses in acclimatizing them were large, practically making the venture prohibitive. By the use of peat he is able to almost totally overcome this loss. I know of one herd of 300 white faced calves taken from Iowa that received no other treatment but his make of feed containing peat, of which he tells me he did not lose a single head. A good part of his feed is cotton seed product. I am not familiar with the feeding of cotton seed meal but am told it cannot be fed alone, and not even very largely mixed into other feeds for any length of time. It causes serious trouble with stock and often death. With peat, however, it can be safely fed right along indefinitely.

In my opinion the greatest value in peat as an addition to feed is its corrective qualities, produced by the ingredients it contains, and made available when properly prepared. In other words such peat becomes a balance divider thus enabling the animal fed to properly assimilate such feed stuff ingredient of the feed used. This enables the feeder to force his feed with a degree of safety and fatten his stock from ten to thirty days earlier with the same amount of feed that he would use without the peat.

HUMUS; NATURE'S SOIL BUILDER.

In these strenuous days of intensive farming—or getting all there is out of it—the study of soil building is receiving merited attention. A few years ago fertilization, other than barnyard manure, was unheard of.

Today the application of commercial fertilizer to poor clay or sandy soils is general and has a marked effect in producing larger yields and better crops.

But the tiller of the soil has one step farther to go. He must feed his land as well as his crops. Fertilization develops and stimulates plant life, but it requires humus to nourish and build up the soil.

A successful and largely practised method for strengthening the soil is in the planting of legumes. These soil builders are permitted to mature and are then plowed under so that they may decay and create conditions suitable to the life

and activities of the nitrifying bacteria, indispensable agencies to all plant and tree life.

A better, much cheaper and a more immediate means of accomplishing successful and lasting soil building is the rapidly growing method of applying specially prepared humus direct to the soil. It can be used to profitable advantage for all plant growth. It is equally good for the flower bed, the lawn, the garden, the field, the orchard or grove.

The use of prepared humus to build up the soil and stimulate plant life is practised today by florists, nurserymen, truck growers, fruit growers and by those who delight in the healthy rose bed, the thrifty vegetable garden, the vigorous grove and the luxuriously green lawn.

Officials of the United States Department of Agriculture maintain that no soil actually wears out, but becomes exhausted through the wasting away of humus, and to bring it back again to normal fertility humus must again be supplied. Well posted farmers realize this and most of them use legumes as cover crops for the purpose of securing a cutting of hay and then plowing in the stubble to supply a part of the humus that is lacking. The question arises, isn't there a better, cheaper ,and quicker way? Legumes in exhausted soils will not prosper and inoculation of the soil with bacteria is necessary. A much quicker and more satisfactory method is to apply humus, which carries its own bacteria· Agricultural experts further claim that soils contain sufficient phosphorus and potash, and the air plenty of nitrogen, and that if the farmer maintains a generous supply of humus his soil will remain strong, fertile and productive. As humus dissappears, so does nitrogen, for nitrogen resides in organic matter. With the loss of humus, soil also loses its capacity to retain moisture and dries out in hot weather or drought. It is out of balance and has lost its physical condition. When land has been worked too long with no benefits bestowed, it will become more and more depleted until a proper amount of humus or organic matter has been supplied.

—Robert Ranson, Pablo Beach, Fla.

UTILIZATION OF MUCK LANDS.

(Extracts from Bulletin 273 of the Michigan Agricultural College Experiment Station.)

THE USE OF MUCK OR PEAT ALONE FOR FERTILIZING PURPOSES.

Its possible value for this purpose lies in the fact that it contains considerable quantities of nitrogen, the most expensive of the three common fertilizer elements, and that it consists largely of organic matter which might serve as a source of humus. This latter material is exceedingly important from the standpoint of soil fertility. It cannot be supplied by the ordinary commercial fertilizer. The barnyard manure made on the farm is usually insufficient in quantity to maintain an adequate supply of humus in the soil and most farmers hesitate about devoting a season's crop to the purpose of green manuring. While there can be no doubt as to the enormous benefits from the turning under of green manure and although its practice is highly recommended, there are still conditions where a substitute could be used to advantage. Any material which would serve this purpose or which would supplement the manure made on the farm would be of immense value to the farmers of the state. Unfortunately, raw muck when applied directly to the soil frequently has but little fertilizing value. The reason for this is that there are two classes of nitrogenous materials, one including nitrate of soda, sulphate of ammonia and dried blood, which can be used immediately by the crops, and the other consisting of raw leather, carpet mill waste, etc., which requires a long time in which to decompose in the soil and become available for plant food. Most muck in the raw state belongs to the latter class and consequently requires some treatment to make its nitrogen directly useful for plants.

While the raw material does not appear to be suitable for fertilizing purposes when used alone, several experimenters have obtained excellent results by using it in connection with barnyard manure. There may be several reasons for this. In the first place the organic matter of the manure may, by direct chemical means, or by aiding indirect bacterial action, cause more rapid decomposition in the peat, with consequent liberation of active nitrogen. On the other hand the peat may simply act as an absorbent of the liquid and gases formed in the decay of manure which would otherwise be lost in the air and drainage water. Still another factor may be concerned in the explanation of the phenomenon. In the decomposition of one or both of the materials in the soil, substances may be formed which are poisonous to plant growth. In the presence of the other however, this toxicity may be neutralized and consequently better results obtained. With the idea of verifying these results and determining how much of the nitrogen of the peat could be made available in this way, experiments were started three years ago at this Experiment Station. While they are not yet com-

plete, the results show up quite favorably for the use of a mixture of peat and barnyard manure. Since these experiments will be described in detail when completed, only a brief summary of the results so far obtained will be given.

The tests were carried out in large galvanized iron cylinders 2 x 6 feet in size set in the ground. These cylinders were so constructed that the drainage water from the soils with which they were filled could be collected and analyzed. They were filled to within a foot of the top with a light sandy soil. The top ten inches were then filled with (1) a mixture of sand and peat, (2) a mixture of sand and manure, and (3) a mixture of sand, peat and manure. To these three sets of mixtures were then added lime, gypsum (land plaster) and acid phosphate.

Table 9 gives the relative amounts of nitrogen found as ammonia and nitrate in the drainage water taking that formed in an untreated cylinder as 1.000.

TABLE 9.

	Lime.		Gypsum.		Acid phosphate.		Nothing.	
	Fallow	Cropped	Fallow	Cropped	Fallow	Cropped	Fallow	Cropped
Peat	1.7904	0.8104	1.8909	0.5779	0.8005	0.4929	0.0176	0.5636
Peat & Barn. man.	3.0519	2.4090	2.9793	1.6992	4.7216	1.9296	7.0993	Lost
Barnyard manure	1.7690	0.8667	1.8003	0.9231	2.6583	1.0143	0.9232	0.8847

In these figures no account is taken of the nitrogen removed by the crops so that the results with the cropped cylinders are of minor significance in this table. However there can be no question about the comparative results of the fallow cylinders. In every case the nitrogen found in the available forms is much greater with the mixture of peat and manure than with either of the constituents alone. This may offer an explanation for the beneficial results obtained from the use of manure on muck lands as well as the application of a mixture of muck and manure to the soil instead of manure alone. By the use of such a mixture nitrification is apparently accelerated and the inert nitrogen compounds made available more quickly than when these materials are used separately.

MUCK AS A COMPOSTING MATERIAL.

Composting produces a concentrated fertilizing material in convenient form for handling and in a condition better suited for use on light soils than in fresh manure. The processes which take place in a compost heap are fermentative in nature and are produced by bacteria. The regulation of these processes and the conservation of the products formed are essential to the economical use of the process. This regulation is largely accomplished by keeping the compost heap moist. During the course of the decomposition in the heap the nitrogenous

materials of the manure are largely broken down into ammonia, a compound which is exceedingly valuable for fertilizing purposes. It is a gas, soluble in water, and hence is liable to be lost in two ways, by escaping into the air and by being carried off in the drainage, a certain amount of which is unavoidable in the addition of water to prevent overheating. This drainage also represents a source of loss for the other fertilizer ingredients. To minimize these losses it is necessary that the material used with the manure in the compost heap shall be a good absorbant. Many materials such as straw, earth, sod, muck and peat have been used for this purpose, but the last is by far the best. As an absorbent for liquids and gases it is unsurpassed. It is a powerful deodorizer and when used in a compost heap, other waste products of the farm such as dead animals, garbage, etc., may be added to it and allowed to decompose with the production of fertilizing material without danger of creating a nuisance. Peat has been used for this purpose for many years and its value is unquestionable. In addition to this it also furnishes a large amount of nitrogen. If we assume that cattle produce 25,000 pounds and horses 15,000 pounds of manure per 1,000 pounds live weight per year, and that cattle are kept in the barn six months of the year, we have an approximate production of 101,250 pounds in a herd of five cows and two horses. The fertilizing ingredients of this under ordinary conditions would represent a value of $120.00. The value of the manure would be practically doubled by composting with one-third its weight of peat containing 2% nitrogen. This percentage is, however, frequently exceeded.

While in the raw state the nitrogen compounds in peat are quite unavailable for plant use, the decay in the compost heap converts a large proportion of them into a readily soluble form. Thus the fertilizing value of the manure is almost doubled by the use of peat in the compost heap, while the maximum amount of fertilizing elements in the mixture is retained and the noxious odor from the pile greatly reduced. The product so obtained is also capable of being more evenly distributed through the soil and is less likely to burn out a crop on light soil than is fresh manure. Wherever manure has to be stored for any length of time this is a very good way of utilizing a peat deposit.

THE USE OF PEAT AS A STABLE LITTER.

The chief requisite of a good litter is that it shall possess great absorbent power and that it add fertility to the manure is also desirable. Straw, the most common litter, is not well suited for the purpose in either of these respects, especially in the quantities and form in which it is ordinarily used. Because it is produced on every farm and the fact that its use as a litter represents the best way of disposing of it, it will of course continue to be used in this way. Its value might be greatly increased, however, by using more of it and having it cut fine. The coarser it is, the lower the absorbing power.

In peat we find a material which is naturally well adapted for the purpose in question, its absorptive power for both liquids and gases being exceptionally high. By absorbing the liquid manure the most valuable portion is saved since it contains about 56% of the nitrogen and 80% of the potash of the total manure. Furthermore, the plant-food in the liquid form is immediately available for plant use while the solid manure must first be decomposed in the soil before the elements can be taken up by the crop. Consequently the preservation of the liquid manure is of much greater importance than the care of the solid. The most disagreeable feature of the manure, especially around dairy barns, is its odor. This is due to gases given off in the rotting processes which begin almost as soon as the manure is made. Ammonia is also formed in this process, and is likely to escape into the air and be lost. The remarkably high absorptive power of peat for gases makes it a remedy for both these evils. Barns in which peat is used as a litter are notably free from the usual characteristic odor of manure. As in the case of composting, peat also adds considerable fertilizing value to the manure in the form of nitrogen compounds and organic matter.

The following table contains the results of experiments made on different litter materials which were sent to the laboratory from various parts of the State. They substantiate the above statements. Using straw as a basis of comparison it will be seen that shavings and excelsior absorb only about three quarters as much liquid while sawdust and fibrous peat take up respectively two and four times as much. Two of the samples of black muck were practically equal to straw in absorbent power but of course exceeded it in fertilizing value. The brown peat, however, shows a much higher value, indicating that this is the material to use for the purpose in question whenever it is possible to do so.

Sample No.	Material.	Pounds water absorbed by 100 pounds material.	Quantity water absorbed by other materials compared to quantity absorbed by straw.
1	Excelsior	283.9	0.76
2	Shavings	288.4	0.77
3	Straw	374.3	1.00
4	Muck, black	381.8	1.02
5	Muck, black	387.3	1.03
6	Marsh hay	417.2	1.11
7	Muck, brown	558.7	1.49
8	Sawdust	750.9	2.01
9	Peat, brown	850.8	2.27
10	Peat, brown	1,625.3	4.34

The best way to use either peat or muck as a litter is to fill the trenches behind the animals, or in the case of box stalls, to place a layer over the floor and cover it with straw. Otherwise, unless it is of the "peat moss" type it will cake on the animals as it becomes moist. If, however, it is quite fibrous and contains

considerable quantities of moss, it may even be used directly as a bedding, a practice which is finding favor in the east where peat moss is imported to some extent for the purpose.

In districts where manure is scarce, it is highly desirable to increase its quantity to the greatest possible extent without producing unfavorable results. The question naturally arises how much peat can be mixed with a given quantity of manure to get maximum crop increase? In the use of peat for composting and as a litter, a minimum is set by the amount which will properly absorb all of the liquids and gases from the manure. If, however, this minimum could be exceeded it would mean a corresponding increase in the amount of manure. The answer to the question will probably vary with every different deposit and no general statement can be made in regard to it. Each bed must be tested. One set of results obtained with a sample of muck from the northwestern part of this State indicated that a better crop yield could be obtained by using three parts of muck to one of manure than with the manure alone. Where manure is scarce and such muck is available it could be made quite a factor in the maintenance of soil fertility and in crop production.

The value of the mixture of peat and manure may be still further increased by the addition of certain mineral fertilizers. Ordinarily manure is rich in nitrogen and potash and less so in phosphoric acid. Muck contains practically nothing of fertilizing value but nitrogen, consequently the addition of phosphoric acid is generally advisable. This may be applied either as super-phosphate or as raw rock phosphate. The latter is much cheaper and in the presence of the large quantity of decaying organic matter in the manure pile or the compost heap is probably nearly as good. It should be scattered over the heap at each addition of manure or over the manure in the trenches.

Gypsum or land plaster may also be used to advantage as it helps to absorb ammonia and prevent its escape into the air. Quick lime or slaked lime should never be used in connection with manure as they liberate ammonia and cause a loss of this valuable material.

USE PEAT IN POULTRY PENS.

For some years past the leading poultry raisers of the United States have been using peat litter imported from Germany as a bedding and disinfectant in their pens. It absorbs all the valuable volatile elements of the guano and eliminates the necessity of daily cleaning and increases many times the value of the droppings for future fertilizing purposes. As a preventive for chicken cholera and parasites which trouble poultry peat has been found invaluable.

EXPERIMENTAL WORK ON MUCK SOILS.

Co-operative work in conducting tests to ascertain the crops, methods of cultivation and treatment necessary to the successful utilization of the peat, muck, and other types of organic soils in the United States, was begun in 1913 under an agreement between the American Peat Society and the Bureau of Plant Industry connected with the U.S. Department of Agriculture, and is still being carried on.

The American Peat Society undertook to furnish a sufficient area of each of the types of soil in various parts of the country on which to conduct experiments, to provide muck soil for conducting experiments under greenhouse conditions at the Arlington Experimental Farm, and to furnish the labour necessary for cultivation of the trial plats.

The Bureau of Plant Industry provides for supervision of the investigations, and supplies such seeds, plants and fertilizers as may be required.

Reports regarding the work are published only upon authority of the Bureau of Plant Industry. It is estimated that the work must be carried on for at least five years in order to be productive of sufficient data on which to base definite recommendations.

The American Peat Society has appointed a Committee of Agriculture to give special attention to this co-operative work, the members of which are: Mr. Chas. A. Crouse, Syracuse, N.Y.; Mr. John N. Hoff, New York City; Prof. H. C. Thompson, Washington, D.C.; Mr. Paul H. Todd, Kalamazoo, Mich.; and Mr. John Wiedmer, St. Louis, Mo.

The work was begun on a tract of about four acres of cultivated muck soil at Great Meadows, N.J., and Prof. H. C. Thompson has been in charge on behalf of the Bureau of Plant Industry. The work is now in its fourth season and much valuable data has been collected. Field work was begun also in Indiana last season, and it is hoped to extend it to other sections of the country with a view of classifying the various agricultural muck soils, and to determine the best and most economical methods of fertilization and general treatment, and the best and most profitable crops which can be grown on such soils.

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EDITORIAL.

Several months have passed since the preceding number of the Journal was sent out to members and subscribers. Delay in publication has been due partly to financial reasons, and partly to the interference with peat operations in Canada occasioned by war conditions.

Manufacture of peat fuel at Alfred was discontinued in August, 1914, shortly after the outbreak of the war. Last fall the plant was leased by a local firm, and operations were carried on for a short period, practically from August 1st until the close of the season in September. During this time about 900 tons of peat fuel was produced. No work has yet been undertaken this season, the company owning the plant having gone into liquidation owing to financial embarrassments.

Reference was made in our last issue to the international character of the meetings of the Canadian and American Peat Societies, and members of this

Society were invited to attend the ninth annual meeting of the American Peat Society, which was held at Detroit on September 20th-22nd, 1915. A number of members of the Canadian Peat Society were in attendance at the sessions which proved to be of unusual interest.

The most notworthy feature of the Convention was the marked attention paid to those phases of the utilization of peat and peat lands more particularly connected with agricultural development of peat and muck lands and agricultural uses of peat generally. Practical papers dealing with various phases of the subject were read by Paul H. Todd of Kalamazoo, H. E. Wiedemann of St. Louis, Mo. and John Wiedmer of the same place and others, several of which appear in the present issue of our Journal.

Our readers who are interested in this branch of peat development will find the opening article, devoted to Prof. Bottomley's discoveries in connection with the fertilizer value of bacterized peat, of special interest at the present time. The present issue marks somewhat of a departure from our usual practice inasmuch as it is devoted almost entirely to the agricultural utilization of peat and peat lands. When, as at the present time, the importance of increased agricultural production is being constantly urged, it is hoped that the discussion of the potential fertilizing and crop producing value of the enormous deposits of humus contained in our peat bogs will be found timely and of practical value.

A communication received from the Secretary of the American Peat Society announces the death at his home in New Hampshire of Prof. Charles A. Davis of the United States Bureau of Mines staff. The name of Prof. Davis has long been a household word among the peat men of the United States, and his work for and in connection with the American Peat Society has been of inestimable value. Members of our Society who have met Prof. Davis at the annual gatherings either in the United States or Canada will learn with deep regret of his untimely demise.

PEAT AND THE WAR.

Among the results of the present conflict in Europe has been a marked growth of interest in the economic uses of peat, both in the industries and in agriculture.

A recent article in the Scientific American states that sphagnum is being largely used in Great Britain for surgical dressings, replacing prepared cotton wool for that purpose.

From a surgical standpoint sphagnum moss is in many ways superior to other dressings. It has an enormous capacity for absorption of moisture, such as wound seepage, for the cellular processes quickly lead liquids from the direct

point of absorption and distribute them through the entire pad or compress of peat moss. This is highly desirable, for with cotton wool liquids quickly work through the bandages, clothing or bedding, to their detriment.

Sphagnum is much more springy than cotton wool, its touch upon the bare skin is more grateful, and it does not mat under the compression of bandages.

The economic gain from the use of sphagnum is also considerable. It has been estimated that, were cotton wool used exclusively in the hospital service, the cost would be not less than $200,000 per annum throughout the war to Great Britain alone, while the cost of the moss is practically negligible.

The moss is pulled by hand, dried on netting in the open air, and all twigs, grass, leaves and other foreign matter carefully removed. Following its cleaning, the moss is sterilized, and, after a final drying, is packed in muslin bags for shipment in case lots.

Many cases of these dressings have been used in France and Belgium. Sphagnum has also been used at Malta, Alexandria, Gallipoli, and in Serbia.

In Great Britain and Ireland much interest has been aroused in the agricultural use of peat by the experiments of Prof. Bottomley with bacterized peat as a fertilizer.

Especially in Ireland projects are rife for wider utilization of the peat bogs. Since the troubles of the Emerald Isle are now held to be chiefly economic in their origin, it is an interesting matter of speculation what would have been the effect on the conditions prevailing in Ireland had the peat bogs been utilized as have those of Holland.

In Ireland it is estimated that there are 4600 square miles of peat bogs, practically all unworked. In the Netherlands probably a similar area of bog lands has up to now been cleared and put under cultivation. The peat bogs of Northern Holland alone furnish about $3,000,000 worth of fuel annually, and over 200,000 tons of moss litter and peat dust. About 10,000 families are employed in the peat fields, and many prosperous towns owe their existence and prosperity to the peat industries.

The peat of Holland is worked under government concessions, and after the peat is removed the land must be left fit for cultivation. By the use of artificial fertilizers such ground is soon brought into a high state of cultivation. As soon as the growing of grain and the raising of potatoes is sufficiently developed, factories for the manufacture of strawboard and potato flour are established, and in a few years thriving communities spring up where formerly all was waste land. The sites of the former peat bogs of Holland are now occupied by some of the most productive agricultural lands in the world. Possibly under the new Home Rule conditions to prevail in Ireland after the war there will be some organized effort made to emulate the example of Holland in the utilization of Irish peat bogs.

In the Scandinavian countries development has been chiefly towards the greater technical use of peat, especially to improve its quality as fuel, and to recover its ammonia and other by-products.

Importations of fuel having been greatly curtailed owing to shipping conditions, Holland is using increased amounts of peat as fuel, and also is employing it for the production of illuminating gas.

In Russia also, the prevailing high prices of coal and oil have wonderfully stimulated the production of peat fuel, which is being carried on upon a very large scale and over a great extent of country. Russian peat operators are now turning their attention to the introduction of improved machinery, whereby the output may be increased with the same labour.

The agricultural value of the peat lands of Germany is under present conditions a valuable economic asset. Of late years agricultural commissions have been formed, and numerous investigations undertaken with a view to utilize the peat lands to the fullest extent possible for agricultural purposes. Sphagnum moss is also used in Germany to take the place of cotton wool for surgical dressings. The peat layers below the moss are being used as packing material, while the denser peat is dried and rubbed to coarse grains to take the place of cork for insulation purposes.

ARTICLES IN BACK NUMBERS.

The following articles and references to agricultural uses of peat and peat lands have appeared in former issues of the Journal.

MAY AND AUG., 1912. (Double Number).

Peat as an Agricultural Asset.
Thos. S. Gladding, New York.

AUGUST, 1913.

An Investigation as to Preservation of Apples in Peat Mull.
E. Nystrom, Jönköping, Sweden.
Use of Peat in Earth Closets.
Thos. Macfarlane, late Dominion Analyst.

DECEMBER, 1913.

Peat Moss as Litter and for Sanitary Purposes.
W. F. Todd, St. Stephens, N.B.
Bottomley's Bacterized Peat.
Report by J. M. Mussen, Canadian Trade Commissioner, Leeds, Eng.
Moss Litter, British Imports, 1898-1912.

April, 1914.

Agricultural Development of Peat Lands in U.S.
Work of Bureau of Plant Industry.

July, 1914.

The Bacterial Treatment of Peat.
W. B. Bottomley, M.A., Ph. D., F.L.S., Prof. of Botany and Vegetable Biology, King's College, London, Eng. (From Journal of the Royal Society of Arts).

Editorial Comment on above.

Peat Litter and Mull for Hen Houses.

October, 1914.

British Patents on Uses of Peat in Manufacture of Stock Foods.
29,648, Dec. 24, 1912—J. J. Eastick.
7,687, April 1, 1913—Molassine Co. and J. J. A. de Whalley.
9,352, April 21, 1913—F. Sahlfield.

December, 1914.

Preparation of Soil Bacteria.
U.S. Patent, 1,099,121—G. H. Earp-Thomas.

Preparation of Fertilizer from Peat.
British Patent, 10,996, May 9, 1913—L. von Alphen.

April, 1915.

Utilization of Peat Land for Cranberry Culture.
Dr. C. L. Shear, U.S. Department of Agriculture, Washington, D.C.

New Method of Using Peat to Save Farmyard Manure.
Description of the turret covered-courts invented by Dr. Beccari of Florence, Italy.

(Back Numbers of the Journal may be had at 25 cents each. Double Number, 50 cents.)

PATENTS RELATING TO PEAT ISSUED BY THE CANADIAN PATENT OFFICE.

162326—May 4th, 1915.

J. D. Oligny, Montreal.

Assigned to Ideal Gas Syndicate.

Process for producing gas from peat or other substances.

The object of the invention is to devise a simple, cheap and efficient method of generating gas from peat in a moist or wet state.

The peat is first crushed and mixed with petroleum or crude oil, or any suitable carbonaceous substance.

The gas produced by coking of the peat in the retort passes through a series of three condensing coils each provided with a connecting pipe whereby the condensates flow down into a common receptacle. Thence through an outlet at the bottom they are led by a return pipe back into the retort. The gas is collected and drawn by an exhauster into the gasometer.

Claim:—Process for the production of gas from peat or other substances consisting in subjecting the substance to continuous heat and generating gas laden with condensable constituents, then passing said laden gas from a heat zone and condensing and passing the condensates first obtained to a contiguous zone of the heat zone and further passing said gas partly relieved of condensable constituents and condensing the gas thus passed and relieving it of the heavier condensates and draining said heavier condensates to the contiguous zone, then passing the gas thus twice relieved and then condensing said gas and relieving it of the lighter condensates, then drawing said lighter condensates and directing them to the said contiguous zone, then drawing from said contiguous zone the condensates and returning them to the heat zone apart from the outflowing gas, then passing the gas relieved from the condensates and collecting said gas in a collector, then creating a vacuum beyond said collector and drawing said gas into a holder, and intermediately in the line of passage sucking in air and increasing the volume of the gas relieved from the condensates.

163083—May 29th, 1915.

L. B. Lincoln, Chicago, Ill.

Apparatus for and process of distributing peat over drying beds.

Peat is drawn from a receptacle in which it has been deposited after being pumped or excavated from the bog and macerated, having when it leaves the receptacle about the consistency of the ordinary tooth paste sold in tubes. The receptacle may be carried by the pumping or excavating machine so as to move along with the latter as the excavation progresses. A pump, preferably of vacuum type, is connected to the source of supply by a flexible conduit. The

pump may be carried upon the same machine as the source of supply or provided with a carriage of its own. A conduit, which may be limited in length only by the power of the pump to force the peat through it, is laid on the drying bed with one end adjacent to the pump and connected to it by a flexible tube. Distributed along this conduit are discharge outlets to which nozzles may be attached on either side for the discharge of the peat on the drying bed both in advance and in rear of the conduit. The discharge nozzles are carried on the ends of flexible pipes. By attaching one of the nozzles, closing all other outlets, and setting the pump in operation a stream of peat will be discharged, and, by drawing the nozzle along the ground, a strip of peat having a predetermined width and depth will be laid upon the ground. By moving the nozzle ahead and sidewise a second strip may be laid, the operation being continued until the area reached by the nozzle is covered, when the operation may be repeated at a second discharge outlet, and so on until the entire area adjacent to the conduit is covered. As the position of the pump and excavator is advanced, a second conduit may be laid, and the area adjacent to it similarly covered. Meanwhile the first conduit is moved ahead, and the two used alternately as the excavation progresses.

After the peat has been spread the strips may be cut into the required lengths by a suitable cutter.

In order to prevent clogging of the discharge pipe it may be provided just beyond each of the discharge outlets with a suitable gate or globe valve. Alternatively, the discharge pipe may be made in sections.

Eleven claims.

163089—June 8th, 1915.

Ernest V. Moore, Peterboro, Ont.

Peat conveying system.

The object of the invention is to provide a simple and efficient means for conveying the excavated peat from the excavator to a travelling briquetting and spreading mechanism.

Two anchorages are placed at opposite ends of the conveyor, and intermediate supports located at suitable intervals. Electric power is conveyed from a central power house to a motor located conveniently on one of the anchorages and arranged to operate the conveyor. The spreader, which runs parallel with the conveyor, is operated from a trolley line which may be carried by the anchorages and intermediate supports.

Each anchorage consists of a movable track laid upon ties which are held in place by special means, carrying a car upon which the conveyor proper is mounted. To overcome the pull of the conveyor a third rail is provided, mounted on suitable timbers, and facing away from the conveyor.

The cars forming each end of the conveyor comprise a platform mounted by means of wheels on the rails, and having also horizontally arranged wheels bearing against the third rail mentioned. A framework mounted on each car is provided with an extending steady-leg projecting towards the opposite end of the conveyor, which, if desired, may be provided with running wheels travelling on an auxiliary track parallel with the rails on which the anchorage is mounted.

The conveyor itself consists of a pair of cables spliced at their ends into semi-circular rails mounted in the framework mentioned. Below these cables is an endless travelling cable which passes over large rope pulleys horizontally mounted in the framework at opposite ends of the conveyor, and immediately under the semi-circular rails. At one end of the conveyor the pulley is driven by electric motor so that the cable travels continually.

The intermediate supports each comprise a small platform upon which is mounted a framework carrying a cross arm the extremities of which are provided with cable anchors in which the stationary cables rest. The travelling cable is unconnected with the intermediate supports. Above this cross arm is a second cross arm projecting to one side of the support at the extremity of which the wires of the trolley line for operating the spreader are supported by means of suitable insulators. The entire support is mounted by means of running wheels on light tracks located parallel with the anchorage tracks.

The conveyor buckets are suspended from small carriages which travel upon the stationary cables and semi-circular rails mentioned, and are moved by the travelling cable to which they are connected by any suitable gripping device.

In operating the conveyor, the peat from the excavator is delivered into the buckets which are constantly moving, and which are dumped when they reach the spreader and returned to the excavator to be refilled. The spreader moves up and down along the cable between the anchorages under its own power, and is regulated to discharge the briquetted peat at the same rate that the peat is dug up by the excavator. When all the peat within reach of the excavator has been dug, the anchorage carriages are moved at right angles to the direction of the conveyor a suitable distance, the excavator and spreader being similarly moved. The tension of the conveyor cables will cause the intermediate supports to move forward simultaneously with the movement of the anchorages. If they do not come quite into line they may be easily moved by a winch and cable, or a suitable number of the running wheels may be connected to the motor operating the conveyor, or to a special motor, and the carriage moved by electric power. When the whole conveyor has moved forward the rails and ties already passed over are taken up and relaid ahead of it.

Nine claims.

CANADA'S PEAT RESOURCES.

—Canada has 37,000 square miles (23,680,000 acres) of known peat bogs, but these form probably but a small fraction of the total, constituting a potential national asset of enormous value.

—Some idea of the possibilities may be gained from the estimate that 28 acres of peat 9 feet deep should yield 50,000 tons of fuel; enough to supply 100 families for 25 years allowing 20 tons per annum to each family, or enough to furnish a power plant of 100 H.P., using steam engines, with fuel for more than 25 years of 300 ten-hour days, allowing 12 lbs. of fuel per H.P. hour developed. The fuel, if used in a suitable gas producer would last the same plant about 100 years.

—Four bogs within a few miles of Ottawa, examined by Government experts, are estimated to contain over 25,000,000 tons of fuel.

—In 1914, Canada paid to the United States $52,000,000 for coal, most of which went to pay for labor and transportation charges.

—In addition to its use for manufacture of fuel, peat may be utilized to advantage on the bog for production of electric power and the manufacture of important by-products, the chief among these being Sulphate of Ammonia, which sells at $50 to $70 a ton.

Apart from the potential value of our peat bogs as a subsidiary source of fuel supply and for production of sulphate of ammonia, there are numerous other products such as moss litter, peat dust, alcohol, acetic acid, acetone, tar, tar oils, creosote, etc., which might form the basis of paying industries giving employment to many people, where now we have only waste lands.

In the peat bogs of Northern Holland alone it is stated that about $3,000,000 worth of peat fuel is made yearly, and over 200,000 tons of peat moss litter. About 10,000 families are employed in the peat fields, and many prosperous towns owe their existence and prosperity to the industry. In addition to shipments made by rail, it is estimated that peat furnishes annually about 48,000 cargoes to the Dutch canal boats.

The recent discovery by an English scientist of the valuable fertilizing properties of bacterized peat, if experimental results thus far obtained are widely repeated in field culture, is likely to become of great importance to Canadian farmers, gardeners and fruit raisers.

—From all indications, the millions of acres of waste lands in Canada peat bogs may eventually furnish the basis for industries employing a large number of people, and adding enormously to the national wealth.

164843—Sept. 14, 1915.

Nils Testrup, London, England, and Thomas Rigby, Dumfries, Scotland. Assigned to Wet-Carbonizing, Limited.

Treatment of peat.

In wet-carbonizing peat in apparatus proposed by Ekenberg wherein rotating tubular elements are employed, the provision of the rotating elements is a large factor in initial cost of the apparatus and a source of substantial cost in operation, owing to wear and need of replacement of parts.

If the peat pulp to be carbonized is forced through the apparatus at considerable velocity it is possible by this means alone to prevent blocking and other difficulties which the rotation of the elements was intended to avoid, and it becomes unnecessary to provide such rotating elements. The high rate of flow tends to result in incomplete carbonization. The material therefore requires to be maintained for some appreciable period at the carbonizing temperature before it is allowed to cool by transfer of its heat to a fresh quantity of the material.

The invention consists in apparatus for the heat treatment of wet peat in which the peat pulped to a viscous condition is forced through heat exchanging passages by such a pressure that its velocity is such that the same alone prevents deposition and enhances the heat transmission, while it becomes possible to cause agitation within the peat pulp by the use of simple stationary devices, and in which, moreover, the peat after having been raised to the desired carbonizing temperature is maintained at this temperature for a period sufficient to allow carbonizing to proceed to the desired extent.

The carbonizing element is composed of long concentric stationary tubes, say respectively of 3½ inches internal, 4 inches external, and 5 inches internal diameter, and 700 to 1000 feet in total length, which may be divided into five sections or sets of tubes. Hot effluent is pumped through the outer tubes of the first section in a direction opposite to that of the flow of peat pulp through the inner tubes, whereby the latter is regeneratively treated. In a subsequent set of tubes the heat is supplied by means of a steam jacket, and the peat after flowing through the inner tube reverses direction and flows through the outer tube. The material having been raised to the desired temperature passes into a closed vessel provided with a rotating mixer and baffles reducing the flow.

With peat pulp finely macerated and containing about 94% water, from 9 in. to 3 ft. per second has been found a satisfactory rate of flow. The pressure required in the case of an apparatus of the dimensions instanced to give the pulp the desired velocity through the apparatus amounts to several hundred pounds per sq. in., 800 in one particular experiment.

Eight claims.

Production and Thrift

CANADA'S CALL
FOR SERVICE AT HOME

Produce More and Save More

The Empire needs food. If you are not in the fighting line you may be in the producing line. Labour is limited—all the more reason to do more than ever before. Grow food for the men who are fighting for you. The Allies need all the food that you can produce. Every little helps. You are responsible for your own work. If you cannot produce as much as you would like, produce all you can. Work with the right spirit. Put fighting energy into your effort and produce now when it counts. The more you produce the more you can save. Producing and saving are war-service.

Make Your Labour Efficient

In war-time do not waste time and energy on unimportant and unprofitable work. Economize labour. Put off unproductive work till after the war, and, if possible, help in producing something needed now. Let us not waste labour. Canada needs it all. If possible help to feed the Allies. Make your back-yard a productive garden. Cultivate it with a will. Make your labour count for as much as possible.

Do Not Waste Materials

There should be no waste in war-time. Canada could pay the annual interest on her war expenditure out of what we waste on our farms, in our factories, in our homes. Every pound of food saved from waste is as good as a pound of increased production. The way for a nation to save is for every individual to save. France is strong to-day because of thrift in time of peace. The men and women of Great Britain are not only "doing" but are learning to "do without."

Spend Your Money Wisely

Practise economy in the home by eliminating luxuries. Wasting our dollars here weakens our strength at the Front. Your savings will help Canada to finance the war. Save your money for the next Dominion War issue. There can be no better investment.

THE GOVERNMENT OF CANADA

THE DEPARTMENT OF AGRICULTURE — THE DEPARTMENT OF FINANCE

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CLUSTER OF BLUEBERRIES ON A 3 YEAR OLD HYBRID.

Cluster of berries (about ⅞ of natural size) from one of the hybrid bushes shown in Fig. 2. The berries had a very light blue color, firm but juicy flesh, exceptionally delicious flavor, and seeds so small as not to be noticeable when the berries were eaten. The small berries on the cluster were still green and such berries increase rapidly in size during the few days of ripening.

Journal of the Canadian Peat Society

Vol. 4 SEPTEMBER, 1916 No. 3

BLUEBERRIES ON PEAT SOILS.

There have been in progress for some time in New Jersey experiments looking to the commercial growth of blueberries in field plantations, and an interesting bulletin on the subject has recently been issued by the United States Bureau of Plant Industry.*

From this it appears that success in blueberry culture rests on the recognition of two peculiarities in the nutrition of these plants; (1) their requirement of an acid soil; (2) their possession of a root fungus that appears to have the beneficial function of supplying them with nitrogen.

If blueberries are planted in a soil with alkaline or neutral reaction, such as the ordinary rich garden or fertile field, it is useless to expect their successful growth. In such a situation they become feeble and finally die. They require an acid soil, and thrive best in a mixture of sand and peat.

Good aeration of the soil is another essential. It is commonly, but erroneously, supposed that the swamp blueberry (Vaccinium corymbosum), the species chiefly desirable for cultivation, grows best in a permanently wet soil. The three fundamental requirements of successful blueberry culture are, (1) an acid soil, especially one composed of peat and sand; (2) good drainage and thorough aeration of the surface soil; and (3) permanent but moderate soil moisture.

Next in importance to soil conditions is a convenient location with reference to a good market. Situations liable to late spring frosts should be avoided, for while the blueberry plant itself is seldom injured by freezing its crop of fruit is often destroyed in this way. It may be found that provisions for flooding blueberry plantations will save a crop often enough to warrant the installation of flooding equipment. In locating a plantation, therefore, it would be well to choose a situation that could be flooded, if flooding proved later to be commercially advantageous.

*United States Department of Agriculture Bulletin No. 334, Directions for Blueberry Culture, 1916, by Frederick V. Coville, Botanist.

Although blueberry plantations may be formed by the transplanting of unselected wild bushes or by the growing of chance seedlings, neither of these courses is advocated, because neither would result in the production of fruit of an especially superior quality. Until nurserymen are prepared to furnish plants asexually propagated from superior stocks the cultivator should begin by transplanting the best wild bushes, selected when in fruit for the size, color, flavor and earliness of the berry and the vigor and productiveness of the bush. These should be propagated by layering and by cuttings until his plantation is completed. Through a combination of these methods a valuable old plant can be multiplied by several hundred at one propagation, the fruit of

PLANTATION OF 3 YEAR OLD BLUEBERRY HYBRIDS AT WHITESBOG, N.S.
Hybrids between two selected wild stocks: seed sown Sept. 9th, 1912: photograph taken July 27th, 1915. In the third year from the seed they produced their first commercial crop, valued at $37 per acre, gross receipts. The rows are 5 feet apart and plants 3 feet apart in the row, too close a spacing for a permanent plantation.

the progeny retaining all the characteristics of the parent. Detailed directions for carrying out the several methods of propagation are given in the bulletin.

It is important that a plantation should not be made up wholly of cuttings from one bush. When blueberry flowers are pollinated with pollen from their own bush the berries are fewer, smaller and later in maturing than when the pollen comes from another bush. Some bushes are almost sterile to their own pollen. The pollen of a plant grown from a cutting is likewise unsatisfactory for the pollination of the parent plant or of other plants grown from cuttings of it. At least two stocks should be used, a row of plants from one stock being followed by a row from the other. For production of a crop under field conditions insects are required to carry pollen from one flower to another. The

honey bee works little on blueberry flowers, which are pollinated chiefly by bumblebees and some of the solitary wild bees.

The most favorable location for blueberry culture is a moist area with a peat covering and sand subsoil, the peat preferably of such thickness that deep plowing will turn up some of the underlying sand. The land should be so ditched that the water level can be kept at least a foot below the surface of the ground during the growing season. The ground should be plowed to the depth of about eight inches and tilled during the season before planting to kill wild vegetation. Tillage to keep down weeds should be thorough after planting, but should be very shallow over the root mats, not more than two or three inches. The plants are preferably set about eight feet apart each way in the rows.

Manure is not necessary, and in the present state of knowledge may be regarded as dangerous, although in small quantities it serves to stimulate the plants, at least temporarily. The danger from manure apparently lies in its tendency to injure the beneficial root fungus of the plant. Lime is positively injurious to the plants. As no fertilizer is required to make the swamp blueberry fruit abundantly and continuously in suitable peat and sand soils properly handled the use of fertilizers in commercial plantations is not advocated. For those desiring to experiment with fertilizers the following acid mixture is recommended, applied at the rate of 1000 lbs. per acre.

	Lbs.
Acid phosphate (16% available phosphoric acid)	600
Sulphate of potash (50% potash)	200
Sulphate of ammonia (20% nitrogen)	200

(Muriate of potash may be substituted for the sulphate of ammonia).

Plants do not come into commercial bearing in field plantations until they are three or four years old when they are from one to three feet high. They then increase slowly to full size and bearing. Wild bushes live to great age, often 50 to 100 years, still bearing heavily, and often attain a height of six to eight feet when growing in full sunlight and more when shaded. The New Jersey plantations have not yet reached mature age, but a small plantation near Elkhart, Indiana, now about 27 years old affords some knowledge of the probable commercial results to be expected. The plantation of about two and a half acres was started in 1889 in a natural blueberry bog which was drained and set with unselected wild blueberries. Better results would undoubtedly have been obtained by careful selection, hybridization and propagation of stock. However the plantation was profitable from the first. Figures are available from 1910 to 1915 inclusive. The former year was one of almost entire failure from spring frosts. For the five years 1911-1915 the

average yield was over 2000 quarts of fruit per acre, yielding at an average price of 14 cents an annual profit of $137 per acre. The annual expenses for weeding, cultivation and irrigation were about $20 per acre. Cost of picking five cents a quart. Maintenance of equipment about $2 per acre, crates and boxes being used repeatedly. In the computation of profits $12 per acre was allowed for interest, $2 for taxes, and $4 for depreciation or sinking fund.

Only a beginning has been made in improvement of the blueberry. By selecting superior wild strains and hybridization berries seven-eights of an inch in diameter have already been produced in the greenhouse. The yield and profits from such berries in field plantations are not yet known. Blueberry culture has a much more profound significance than the mere addition of another to the list of agricultural industries as it promises to add to the general welfare through the utilization of land otherwise almost valueless, and offers a profitable industry to individual landowners in districts where general agricultural conditions are unpromising.

CANADIAN PEAT INVESTIGATIONS, 1908-1914 INCLUSIVE.

Systematic investigation of the peat bogs of Canada with a view to ascertaining their location, extent, depth, character and suitability for production of fuel and litter has been carried on since 1908. The work has been under the superintendence of Mr. Anrep, son of the late Aleph Anrep, the Swedish inventor of important peat machinery extensively used in Europe.

The bogs thus far selected for investigation have been for the most part those located at convenient shipping points, leaving the extensive areas of the hinterland for subsquent investigation as demand may arise.

During the period from 1908 to the close of the season of 1914, there have been located, delimited, mapped, and investigated as to depth, character and quantity of peat available for commercial exploitation as fuel or litter, 25 bogs in Ontario, 12 in Quebec, 8 in Nova Scotia, 6 in Prince Edward Island, and 7 in Manitoba, 50 in all, covering about 140,000 acres altogether and estimated to be capable of yielding about 115,000,000 tons of fuel. 12 bogs were found to be in part or as a whole adaptable for production of peat litter, having an estimated capacity of production of about 10,500,000 tons.

Seven Ontario bogs investigated within convenient shipping distance of Toronto are estimated to be capable of producing approximately 26,500,000 tons of fuel.

Seven bogs in the Montreal district could furnish that city with 23,500,000 tons of fuel.

FOUR YEAR OLD BLUEBERRY HYBRID.

Hybrid between selected wild plants of a low-bush blueberry (Vaccinium Angustifolium) and a high-bush or swamp blueberry (V. Corymbosum). Photograph taken July 7th, 1915. Some of the bushes were ready to pick two weeks before that time. These 4 year old hybrids yielded more than three times as large a crop as the 3 year old hybrids. The best 4 year old bush bore 2 quarts of berries.

Five bogs along the lower St. Lawrence in Kamouraska and Temiscouata counties, convenient to the city of Quebec by water, are estimated to be capable of supplying 16,250,000 tons of fuel and 5,750,000 tons of peat litter.

Nova Scotia bogs investigated in Yarmouth, Shelburne and Lunenburg counties will produce 6,250,000 tons of fuel and 500,000 tons of peat litter.

Six bogs investigated in Prince Edward Island can furnish 1,250,000 tons of fuel and over 1,000,000 tons of litter.

The seven bogs investigated in Manitoba make no great showing as to fuel production, the aggregate production being placed at less than 2,000,000 tons, but the Julius bog, with an estimated production of about 2,500,000 tons is one of the most extensive peat litter bogs thus far examined.

In addition to the bogs surveyed, preliminary investigations have been made of nearly 250,000 acres of marsh lands in Manitoba, mostly too shallow or not sufficiently humified for manufacture of fuel.

The following tables summarize in convenient form the outstanding features of the information with regard to bogs examined contained in the several bulletins relating to the subject issued from time to time. At a time like the present when stock is being taken of the natural resources of the country, the importance of these investigations will be readily recognized.

The following bulletins have been issued by the Mines Branch of the Department of Mines recording the progress of the investigations:—

Bulletin No. 1—Investigation of the Peat Bogs and Peat Industry of Canada during the season 1908-09, by Erik Nystrom, M.E. and A. Anrep, M.E.

Bulletin No. 4—Investigation of the Peat Bogs and Peat Industry of Canada during the season 1909-10, by Aleph Anrep, Jr.

Bulletin No. 8—Investigation of the Peat Bogs and Peat Industry of Canada during the season 1910-11, by A. Anrep.

Bulletin No. 9—Investigation of the Peat Bogs and Peat Industy of Canada 1911-12, by A. Anrep.

Bulletin No. 11—Investigation of the Peat Bogs and Peat Industry of Canada 1913-14, by A. Anrep.

Bulletin No. 1 contains reports of investigations of the Mer Bleu, Alfred, Welland, Newington, Perth and Victoria Road bogs, all in Ontario.

Bulletin No. 4 describes the Brunner, Komoka, Brockville and Rondeau bogs.

Bulletin No. 8 records operations of the Government peat plant at Alfred during the season of 1910, and gives detailed accounts of the Crozier, Fort Francis, Coney Island, Lac du Bonnet, Transmission, Corduroy, Boggy Creek, Rice Lake, Mud Lake, Litter and Julius bogs. In addition to these are reports

of preliminary investigations of the Whitemouth, Plum, Netley, Clandeboye, Big Grass, Douglas, McCreary, Ochre River and Dauphin marshes in Manitoba.

Bulletin No. 9. Detailed reports of investigation of the Large and Small Tea Field, Lanoraie, St. Hyacinthe, Riviere du Loup, Cacouna, Leparc, St. Denis and Riviere Ouelle bogs in Quebec, and Moose Mountain bog in Ontario.

Bulletin No. 11. Reports on the Richmond, Luther, Amaranth, Durham, Eastnor, Cargill, Westover, Marsh Hill, Sunderland, Manilla, Stoco, Clairview, Tweed and Buller bogs in Ontario; the L'Assomption, St. Isidore and Holton bogs in Quebec; the Black Marsh, Portage, Miscouche, Muddy Creek, Mount Stewart, Black Banks and Mermaid bogs in Prince Edward Island and the Caribou, Cherryfield, Tusket, Makoke, Heath, Port Clyde, Latour and Clyde bogs in Nova Scotia.

The bulletin is profusely illustrated containing among other things, forty-six full page plates illustrative of the botany of the bogs. Insert maps show clearly the location of the bogs investigated. An important new feature is the inclusion of twenty-four appendices with copies of Canadian patents descriptive of improvements in machinery for the handling and manufacture of peat fuel, including drawings.

PRELIMINARY INVESTIGATIONS.

RICE LAKE—Situated about 7½ miles from Point Dubois, Man. This bog has a very small area, consisting of a comparatively narrow strip surrounding the lake. The peat is poorly humified and cannot be used for the manufacture of peat fuel.

WHITEMOUTH MARSH—2 miles east of Whitemouth, Man. Estimated area 200,800 acres. Approximate area investigated, 97,000 acres. About 39,000 acres lie north of the C. P. Ry. The average depth around the margin is 7 to 8 ft. Average depth of the middle part of the bog is about 11 to 12 feet.

13,000 acres south of the C. P. Ry. have an average depth of 4 to 5 feet.

45,000 acres south of the Transcontinental Railway are heavily wooded and shallow, having an average depth of 2 to 5 feet underlaid principally with a compact blue clay.

The peat is not sufficiently humified for peat fuel and too much humified for peat litter. If drained, humification would proceed rapidly and the area north of the C.P.R. might be utilized for production of fuel. Taking into account the improvement which could result in surrounding farm land consequent upon this drainage, the undertaking would eventually be a paying proposition.

PLUM MARSH—1½ miles southwest of Whitemouth, Man. Approximate area 9,000 acres. The peat is shallow, the average depth 2 to 4 feet and is unsuitable for either fuel or litter, but after drainage the land will eventually be recovered for agricultural purposes.

NETLEY MARSH—1½ miles from Netley, Man. Approximate area, 25,000 acres. Depth of peat varies from 2 to 5 feet and a large portion of the marsh is flooded for the greater part of the year. The northern part is utilized for hunting grounds and the southern part for growing hay.

CLANDEBOYE MARSH—4 miles west of Clandeboye, Man. Approximate area 27,000 acres. This marsh is shallow, averaging in depth from 2 to 5 feet, and is unsuitable for manufacture of fuel or litter, but by drainage valuable land could be recovered for agricultural purposes.

BIG GRASS MARSH—2 miles from Gladstone, Man. Approximate area, 50,000 acres. Varies in depth from 1 to 4 feet. The Manitoba Government are dredging a trench through the bog.

DOUGLAS PEAT BOG—½ a mile from Douglas, and 13 miles east of Brandon, Man. Approximate area, 13,000 acres. Depth 1 to 4 feet, poorly humified and unsuitable for fuel or litter. Valuable agricultural land can be recovered by drainage of this area.

McCREARY MARSH—4 miles east of McCreary, Man. Covers more or less of townships 20 and 21, ranges 14 and 15 west. Depth 1 to 3 feet. Could be used profitably if drained.

OCHRE RIVER MARSH—6 miles northeast of Ochre River, Man. Approximate area, 9,000 acres. Shallow and unsuitable for fuel or litter, but can be drained and utilized for agricultural purposes.

DAUPHIN MARSH—West of Dauphin Lake, Man. Approximate area 6,000 acres. Similar to Ochre River Marsh.

MOOSE MOUNTAIN BOG about 22½ miles from Sellwood Station, Ontario, on the Canadian Northern Railway, has an area of only 9 acres. The peat is well humified and has an average depth of 6 feet, but owing to this small area the bog is of no commercial importance.

ONTARIO.

PEAT BOG	Approx. Area [Acres]	Less than 5 feet deep Acres	5 to 10 feet deep [Acres]	10 to 15 feet deep [Acres]	Over 15 feet deep [Acres]	CONTENTS [Cub. Yds.]	Est. Workable Volume [Cub Yds.]	Est. Fuel Production with 25% Moisture [Tons]	Est. Litter Prodct'n with 20% Moisture [Tons]
1. Mer Bleu	5,004	1,564	2,237	856	347	56,050,711	38,442,494	5,125,665	—
2. Alfred	6,800	1,377	3,084	1,316	1,014	100,182,456	70,270,200	9,369,360	—
3. Wellond	4,900	1,423	2,877	588	—	50,975,000	30,796,480	4,106,200	—
4. Newington	3,800	929	1,191	748	974	62,913,813	46,566,478	6,208,860	—
5. Perth	3,800	678	958	2,098	106	55,522,984	38,445,222	5,126,000	—
6. Victoria Road	67	36	15	12	4	638,709	402,441	53,600	—
7. Brunner	2,288	1,260	1,028	—	—	15,687,545	8,790,979	1,172,130	—
8. Komoka	900	605	295	—	—	4,786,667	1,903,733	253,830	—
9. Brockville	1,400	356	475	490	79	18,601,464	12,705,969	1,694,129	—
10. Rondeau	1,571	959	316	207	89	13,985,477	7,856,581	1,047,544	—
11. Holland	14,641	9,030	4,025	1,025	506	123,592,244	61,641,981	8,218,931	—
12. Coney Island	25	—	25	—	—	322,667	242,000	32,267	—
*13. Crozier	355	—	—	355	—	8,062,963	6,912,223	—	518,291
14. Fort Francis	1,700	929	691	86	—	14,293,368	6,684,040	891,205	—
15. Richmond	5,500	3,340	2,160	—	—	62,777,000	20,908,000	2,788,000	—
16. Luther	4,900	1,000	1,650	1,700	550	73,143,000	55,820,000	7,443,000	—
17. Amaranth	500	275	225	—	—	4,310,000	1,978,000	264,000	—
18. Westover	1,400	1,045	355	—	—	8,411,000	2,290,000	306,000	—

ONTARIO—Continued.

19. Marsh Hill	5,100	1,018	1,446	1,267	1,369	91,214,000	72,156,000	9,620,000	—
20. Sunderland	580	240	340	—	—	4,999,000	2,740,000	365,000	—
21. Manilla	745	380	355	10	—	6,611,000	2,990,000	399,000	—
22. Stoco	1,285	361	666	230	28	14,808,000	10,086,000	1,345,000	—
23. Clairview	280	280	—	—	—	451,733	—	—	—
†24. Tweed	50		50						
**25. Buller	100		100						

*Average depth 14 ft. †Average depth 4 to 8 ft. **Average depth 5 to 7 ft.

QUEBEC.

PEAT BOG	Approx. Area Acres	Less than 5 feet deep Acres	5 to 10 feet deep Acres	10 to 15 feet deep Acres	Over 15 feet deep Acres	CONTENTS Cub. Yds.	Est Workable Volume Cab. Yds.	Est. Fuel Production with 25% moisture Tons	Est. Litter Prodct'n with 20% Moisture Tons
1. Large Tea Field	5,268	1,960	2,131	1,177	—	56,335,000	36,179,000	4,823,867	—
2. Small Tea Field	4,190	1,800	1,530	860	—	41,250,900	24,866,304	3,315,507	—
3. Lanoraie	7,500	3,966	2,830	500	204	72,627,700	35,636,295	4,751,500	—
4. St. Hyacinthe	3,890	1,394	1,390	1,074	32	44,026,300	27,494,850	3,665,980	—
5. Riviere du Loup	7,220	893	1,500	2,900	1,927	140,425,000	94,579,816	12,610,643	—
							19,360,000	—	1,927,666
6. Cacouna	845	262	215	264	104	15,290,000	8,371,581	—	602,773
7. Leparc	614	123	148	239	14	7,458,100	5,373,407	716,455	—
8. St. Denis	315	34	63	77	141	7,127,000	6,053,703	—	453,912
9. Riviere Ouelle	4,521	802	879	919	—	31,598,000	21,911,110	2,921,481	—
					1,921	58,670,000	36,440,747	—	2,623,734
10. L'Assomption	1,565	256	722	555	25	16,809,000	13,200,000	1,760,000	—
11. St. Isidore	1,931	439	1,002	490	—	22,159,000	16,810,000	2,242,000	—
12. Holton	6,181	2,704	3,477	—	—	51,050,000	22,400,000	2,999,000	—

PRINCE EDWARD ISLAND.

PEAT BOG	Approx. Area [Acres]	Less than 5 feet deep Acres	5 to 10 feet deep [Acres]	10 to 15 feet deep [Acres]	Over 15 feet deep [Acres]	CONTENTS [Cub. Yds.]	Est. Workable Volume [Cub. Yds.]	Est. Fuel Production with 25% Moisture [Tons]	Est. Litter Prodct'n with 20% Moisture [Tons]
1. Black Marsh	650	480	170	—	—	3,970,000	1,370,000	183,000	—
2. Portage	627	267	360	—	—	5,789,000	3,766,000	502,000	—
	148	—	—	110	38	2,930,000	2,460,000	—	184,000
3. Miscouche	2,797	2,411	386	—	—	12,138,720	3,110,000	415,000	—
	103	—	—	103	—	2,160,000	1,827,000	—	109,000
4. Muddy Creek	61	61	—	—	—	347,000	—	—	—
5. Black Banks	884	255	179	215	235	14,413,000	11,180,000	—	838,000
6. Mermaid	186	84	94	8	—	1,459,000	860,000	115,000	—

MANITOBA.

PEAT BOG	Approx. Area [Acres]	Less than 5 feet deep Acres	5 to 10 feet deep [Acres]	10 to 15 feet deep [Acres]	Over 15 feet deep [Acres]	CONTENTS [Cub. Yds.]	Est. Workable Volume [Cub. Yds.]	Est. Fuel Production with 25% Moisture [Tons]	Est. Litter Prodct'n with 20% Moisture [Tons]
1. Lac du Bonnet	249	180	69	—	—	1,258,400	445,280	59,371	—
2. Transmission	1,375	1,375	—	—	—	10,648,888	7,022,840	936,379	—
3. Corduroy	100	100	—	—	—	649,037	322,666	43,023	—
4. Boggy Creek	661	216	406	39	—	7,065,508	4,257,049	567,607	—
5. Mud Lake	139	—	139	—	—	2,011,667	1,564,629	208,617	—
	28	—	28	—	—	451,733	361,387	48,173	—
6. Litter	82	—	—	40	42	1,664,795	1,389,739	—	104,230
7. Julius	3,896	996	1,954	946	—	44,382,514	32,651,756	—	2,448,881

NOVA SCOTIA.

PEAT BOG	Approx. Area Acres	Less than 5 feet deep Acres	5 to 10 feet deep Acres	10 to 15 feet deep Acres	Over 15 feet deep Acres	CONTENTS Cub. Yds.	Est Workable Volume Cab. Yds.	Est. Fuel Production with 25% moisture Tons	Est. Litter Prodct'n with 20% Moisture Tons
1. Caribou	687	342	215	130	—	4,372,000	1,960,000	262,000	—
	200	—	—	—	200	6,417,000	5,815,000	—	436,155
2. Cherryfield	160	27	46	30	57	2,796,000	2,240,000	299,000	—
3. Tusket	235	82	105	48	—	2,576,000	1,936,000	258,000	—
4. Makoke	460	120	240	100	—	5,445,000	3,560,000	475,000	—
5. Heath	2,024	813	1,087	120	4	19,790,000	12,350,000	1,646,000	—
	150	12	124	14	—	1,629,000	1,380,000	—	104,000
6. Port Clyde	1,666	955	552	159	—	13,690,000	7,660,000	1,021,000	—
7. Latour	849	273	419	157	—	8,855,000	5,660,000	755,000	—
8. Clyde	2,240	1,390	520	180	150	18,225,000	11.590,000	1,545,000	—

ONTARIO	67,691	27,085	24,564	10,988	5,066	792,340,801	500,628,821	65,829,721	518,291
QUEBEC	44,040	14,633	15,887	9,055	4,368	564,826,000	368,676,813	39,806,433	5,608,085
NOVA SCOTIA	8,671	4,014	3,308	938	411	83,795,000	54,151,000	6,261,000	540,155
P. E. I.	5,456	3,558	1,189	436	273	43,206,720	24,573,000	1,215,000	1,131,000
MANITOBA	6,530	2,867	2,596	1,025	42	68,132,542	48,015,346	1,863,170	2,553,111
Grand Totals	132,388	52,157	47,544	22,442	10.160	1,552,301,063	996,044,980	114,975,324	10,350,642

PEAT LITTER BOGS INVESTIGATED.

BOG	Est. production Peat Litter 20 % Moisture Tons	Absorptive Capacity		Phosphorus %	Nitrogen %	
		Dry	25 % Moisture			
Ontario						
Crozier	518,291					
Quebec						
Riviere du Loup	1,927,666	11.4		.037	1.0	
*Cacouna	602,773					
St. Denis	602,772					
Riviere Ouelle	2,623,734			.037	0.9	
Nova Scotia						
Caribou	436,155	13.6	9.9			
†Heath	104,000	8.2	5.9			
Prince Edward Island						
Portage	184,000	12.6	9.2			
Miscouche	109,000	15.6	11.5			
**Black Banks	838,000	15.2	11.1			Top layer 1 metre.
		17.4	12.9			2nd layer 1 metre.
		16.	11.8			3rd layer 1 metre.
Manitoba						
Litter	104,230			.030 .041	1.35	
Julius	2,448,881			.028 .057	1.0	

*Contains too much humus to produce a first-class litter.

†Did not behave like the other peat litters, but formed a kind of gelatinous mud in the wire basket, through which water ran with difficulty and as the area is comparatively small, it would not be advisable to erect a peat litter plant on a commercial basis.

**Ash in moisture free peat, surface layer, 2.7, 2nd layer, 3.7, 3rd layer, 4.4.
††Absorptive capacity about satisfactory.

ONTARIO.

PEAT BOG	Partial Analysis of Absolutely Dry Peat: Valuable Matter %	Fixed Carbon %	Ash %	Nitrogen %	Calorific Value B T U per lb.	OCATIONS AND SHIPPPING FACILITIES
1. Mer Bleu	68.40	25.00	6.60	1.26	9126	8 miles from Ottawa on C. P. Ry. and G. T. Ry.
2. Alfred	68.13	26.56	5.31	1.76	8730	Near Alfred Station, Prescott County, on C.P.R. 42 miles from Ottawa.
3. Welland	70.53	24.28	5.19	1.44	8667	6 miles from Welland on Welland Canal.
4. Newington	67.07	26.27	6.66	1.76	8465	At Newington Station on N.Y. & O. Ry., 40 miles from Ottawa.
5. Perth	71.51	24.60	3.89	1.80	9148	1½ miles from Perth Station, Lanark County, C. P. Ry.
6. Victoria Road	69.52	25.18	5.30	—	8649	1 mile from Victoria Road Station, Midland Division, G.T.R.
7. Brunner	64.09	25.16	10.75	1.73	8850	8 miles from Stratford. Traversed by G. T. Ry.
8. Komoka	60.90	18.52	20.58	1.63	7490	2 miles from London, on C.P.R. and G.T.R.
9. Brockville	66.70	21.75	11.75	2.41	8173	3 miles from Brockville on C.P.R.
10. Rondeau	61.00	22.90	16.10	2.77	7914	6 miles from Blenheim on Lake Erie.
11. Holland	63.50	26.20	10.50	2.67	8510	Just east of Bradford in Simcoe & York Counties.
12. Coney Island						On Coney Island in Lake of the Woods, 1 mile west of Kenora.
13. Crozier						6 miles southwest of Fort Francis, Rainy River District.
14. Fort Francis	62.40	28.90	8.70	—	8910	1 mile west of Fort Francis, Rainy River District.
15. Richmond	60.54	28.06	11.40	2.00	8854	2½ miles south of Richmond, Carleton County.
16. Luther	61.70	27.50	10.80	1.67	8364	7 miles from Grand Valley, Dufferin County (2½ miles from C. P. Ry.)

ONTARIO—Continued.

17. Amaranth	59.90	27.20	12.90	1.70	8710	4 miles from Crombie Station, Dufferin County.
18. Westover	55.60	24.10	20.30	2.30	7920	4 miles south of C.P.R. in Wentworth County.
19. Marsh Hill	60.85	26.48	12.67	2.18	8068	Extends from 1 mile north of Uxbridge to 1½ miles south of Cannington, Ontario County.
20. Sunderland	60.50	28.30	11.20	2.00	8280	1 mile north of Sunderland, Ontario County.
21. Manilla	59.90	28.80	11.30	2.10	8100	2 miles from Mariposa Station, Ontario County (G.T.R. ½ mile from bog.)
22. Stoco	60.97	23.13	15.90	2.37	7557	½ mile from Stoco Station, Bay of Quinte Ry., Hastings Co.
23. Clairview						4 miles from Erinville Station, Bay of Quinte Ry., Hastings Co.
24. Tweed						1 mile south of Tweed Station, Hastings County.
25. Buller						1 mile from Buller Station, Hastings County.

QUEBEC.

PEAT BOG	Partial Analysis of Absolutely Dry Peat					LOCATION AND SHIPPING FACILITIES
	Valuable Matter %	Fixed Carbon %	Ash %	Nitrogen %	Calorific Value B T U per lb.	
1. Large Tea Field	65.50	29.00	5.50	2.00	9400	2 miles northwest of Huntingdon Station, Huntingdon Co.
2. Small Tea Field	64.50	29.00	6.50	2.00	9200	4½ miles from Huntingdon Station, 1½ miles from Port Lewis Wharf.
3. Lanoraie	65.00	27.65	7.35	2.00	8967	At Lanoraie Station, 40 miles from Montreal. Traversed by C. P. Ry.
4. St. Hyacinthe	63.50	30.50	6.00	2.00	8850	2 miles from St. Hyacinthe Station on C. P. Ry.
5. Riviere du Loup	68.60	28.60	2.80	1.00	9280	1 mile south of Riviere du Loup Station, Temiscouata County.
6. Cacouna						At Cacouna Station and traversed by C. P. Ry.
7 Leparc	69.00	28.00	3.00	1.00	9000	Near Cacouna Station and traversed by C. P. Ry.
8. St. Denis						1 mile from St. Denis wharf, Kamouraska County and on branch line of I. C. Ry.
9. Riviere Ouelle	68.00	29.00	3.00	1.00	9200	1 mile from Riviere Ouelle Station, Kamouraska and on I. C. Ry.
10. L'Assomption	67.00	28.65	4.35	2.00	9700	2 miles from L'Epiphanie Station, L'Assomption County.
11. St. Isidore	62.00	32.00	6.00	2.00	8900	3 miles south of St. Isidore Station.
12. Holton	59.00	27.00	14.00	2.00	8500	2 miles east of Holton Station.

PRINCE EDWARD ISLAND.

PEAT BOG	Partial Analysis of Absolutely Dry Peat: Valuable Matter %	Fixed Carbon %	Ash %	Nitrogen %	Calorific Value B T U per lb.	LOCATIONS AND SHIPPING FACILITIES
1. Black Marsh	65.00	30.00	5.00	0.85	9800	6 miles from Tignish, Prince County.
2. Portage						1 mile from Portage Station, Prince County.
3. Miscouche	63.00	30.00	7.00	1.35	9400	1 mile from St. Nicholas Station, traversed by P.E.I. Ry.
4. Muddy Creek						3 miles southwest of St. Nicholas Station.
5. Black Banks						5 miles south of Alberton.
6. Mermaid	67.00	29.00	4.00	1.05	9800	2 miles from Mount Herbert Station on the I.C. Ry.

MANITOBA.

PEAT BOG	Valuable Matter %	Fixed Carbon %	Ash %	Nitrogen %	Calorific Value B T U per lb.	LOCATIONS AND SHIPPING FACILITIES
1. Lac du Bonnet	59.40	25.00	15.60	1.40		4 miles west of Lac du Bonnet.
2. Transmission	56.80	24.20	19.00	1.60		18 miles from Point Dubois.
3. Corduroy						14 miles from Point Dubois.
4. Boggy Creek	59.00	22.55	18.45	2.50	8730	12 miles from Point Dubois.
5. Mud Lake	69.10	23.20	7.70	1.50	8760	3 miles from Point Dubois.
6. Litter	66.10	26.20	7.70	1.55	9090	2 miles from Point Dubois.
7. Julius						1 mile west of Shelley.

NOVA SCOTIA.

PEAT BOG	Partial Analysis of Absolutely Dry Peat: Valuable Matter %	Fixed Carbon %	Ash %	Nitrogen %	Calorific Value B T U per lb.	LOCATION AND SHIPPING FACILITIES
1. Caribou	65.37	30.38	4.25	1.18	9665	1½ miles from Berwick on Dom. Atl. Ry.
2. Cherryfield	64.10	29.80	6.10	1.10	9450	½ mile from Cherryfield Station, Lunenburg County.
3. Tusket	61.00	28.80	10.20	1.70	9255	Near Tusket Station, Yarmouth County.
4. Makoke	66.00	28.80	5.20	1.55	9415	1½ miles south of Tusket Station.
5. Heath	64.30	28.72	6.98	1.55	9455	1 mile from Central Argyle Station, Yarmouth County.
6. Port Clyde	66.75	29.95	3.30	1.13	9665	3 miles from Port Clyde Station, Shelburne County. Traversed by Halifax & Southwestern Ry.
7. Latour	67.95	28.15	3.90	1.10	9290	1½ miles from Upper Port Latour, Shelburne County.
8. Clyde	64.88	30.16	4.96	1.20	9506	2½ miles from Clyde River Village, Shelburne County.

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EDITORIAL.

THE ALFRED PEAT PLANT.

Elsewhere in this issue appears an advertisement offering for sale the peat plant and property at Alfred, Ont.

An exceptional opportunity is afforded to any one interested in peat development to acquire at low cost a well situated bog already cleared, drained and in condition for working and an up-to-date and efficient plant for the manufacture of peat fuel.

Owing to the war operations at this plant were discontinued some months ago. Subsequent to the successful demonstration of peat fuel manufacture with the Anrep machine, such as are used in large numbers in Europe, combined with a Jacobson field press and movable tracks for spreading the raw

peat on the drying field, which was made by the Government in 1910, the property was acquired by private parties. A new mechanical excavator, according to designs of the late Aleph Anrep, and having about double the capacity of the former plant was erected. During the next three seasons this machine was perfected, and an electrically operated cableway and spreader for distribution of the raw peat on the drying ground, the inventions of Ernest V. Moore, M.E., were erected and the whole plant put into operation.

A company was formed to operate the new plant, and was in process of financing the undertaking when war broke out and the plant was shut down. The company has since passed into the hands of a liquidator. Last year a local firm at Alfred operated the plant for a short time under lease from the liquidator, producing about 900 tons of excellent fuel up to the close of the season. Efforts to lease the plant for the season of 1916 failed owing to the order of the court directing a sale to be made.

Alfred is favorably located with regard to both Ottawa and Montreal markets, and though no sales organization has been effected, results indicate that the entire output of the plant can be readily disposed of at good prices. Last season the fuel sold at $3.50 F.O.B. Alfred, or $5.75 per ton delivered in Ottawa. As coal prices have since advanced materially there should be no difficulty in securing these or higher prices.

Apart from the demand for fuel the product of the plant should readily find market for use by fertilizer manufacturers. Enquiries made some time ago elicited the information that several firms have used peat successfully in the commercial fertilizer trade and could use considerable quantities if available.

PEAT IN BRITISH HOUSE OF COMMONS.

Mr. Boland, in the House of Commons, asked the Minister of Munitions, in view of the fact that sodium nitrate was required in the manufacture of nitric acid as a starting point in the production of explosives and synthetic dyes, if he would take steps to utilize the turf from Irish bogs for peat gas producers. Dr. Addison replying, said the various methods of utilizing peat were receiving the close attention of the Department in connection with the manufacture, not only of ammonium nitrate, but also of other substances useful for war purposes. The researches made by the Dublin College of Science were well known to the officers of the Department and they were already in communication with the persons who owned and worked peat in Ireland for industrial purposes, as described in the Journal of the Irish Department. Most of these methods were still in an experimental stage and their adoption

depended on questions of yield, cost of plant, time required for erection, and the cost of the product. No decision had yet been arrived at upon the subject.

Mr. Boland asked if the hon. gentleman was aware that this system had been in practical operation for the last four years in a factory in Portadown, in Ulster, and the running costs had been reduced by 50 per cent. over the cost of eoal.

Dr. Addison answered that it was a proved fact that various ingredients had been made out of peat useful for the manufacture of explosives, but what they had to consider was whether it was a commercial proposition as compared with other sourees.

In the British House of Commons, on July 12, Mr. Ginnell asked whether the Foreign Secretary had obtained and would make available to those interested in the promotion of peat industries in Ireland after the war any of the information frequently asked regarding the working of such industries in other countries, especially in Sweden, the nature of the bogs, conditions of labour, number employed, processes cost of Anrep and other machinery, output, facilities of transit, and financial results for the latest period for which these were available; if not, whether any deputation was being sent to Sweden to study these things there; and, if not, whether facilities would be afforded to private enquirers to go to Sweden for this purpose.

Lord R. Cecil replied that this matter could not be enquired into at present, but enquiries would certainly be made after the war. He was not aware of any deputation being sent to Sweden to study the question, but if any competent and properly accredited private individuals wished to go there for this purpose, the British Minister at Stockholm would afford all proper assistanee.

PATENTS RELATING TO PEAT ISSUED BY THE CANADIAN PATENT OFFICE.

163598—July 6th, 1915.

J. A. Oligny, Montreal.

Peat drying apparatus.

Object of the invention is to produce peat in the form of a powder for use as fuel. Raw peat is placed in a chamber somewhat in the nature of an oven, which is heated on all sides by the products of combustion from a fire underneath it, which products of combustion are also led into the peat chamber directly over the peat.

166692—December 21st, 1915.

Thomas Rigby, Dumfries, Scotland.

Assigned to Wet Carbonizing, Limited.

Improvements in treatment of peat.

In carrying out the process of peat treatment in which there is a continuous flow of peat pulp throughout the system, regeneration of heat from the treated mass is effected by imparting to fresh material entering the system the heat of vapour evolved from the material already heated. The heat treatment may be accelarated by addition of chemicals or merely by reducing the degree of maceration of the peat or from the hot effluent by passing the latter into a chamber wherein a lower pressure prevails, and then bringing the evolved vapour into contact with cooler material, or by taking up and carrying water vapour to the cooler material by the agency of a gas current passing from the presence of the one to the presence of the other.

Three claims.

167352—Feb. 1st, 1916.

Thomas Rigby, Dumfries, Scotland.

Utilization of Peat.

The invention consists in excavating the peat from the deposit by forming entirely separate and unconnected excavations in sequence in contradistinction to forming a single large working excavation. A small reservoir is formed near the factory, and work commenced in an adjacent area with an excavator mounted on a floating pontoon. The peat excavated, after maceration, is passed into the reservoir until an area of say 30 acres is excavated. The opening between the reservoir and the excavation is then closed by means of a dam, and a channel is cut to another site, leaving a wall about 20 feet thick between the excavations. As the work proceeds new and independent areas are thus excavated and afterwards closed by dams, when they may be separately prepared for agricultural use.

BRITISH AND FOREIGN PATENTS.

British Patent No. 3888 (1914).

Improvements relating to the Utilization of Peat.

M. A. Adam and Wetcarbonizing Limited.

The invention relates to dewatering peat and its utilization (*inter alia* for the production of solid or gaseous fuel, chemical substances of value, such as ammonium compounds, tarry matters and their derivatives, waxy bodies, and the like), by means involving heat treatment, such as wet carbonization aided or not by other agencies, such as acids or appropriate metallic compounds.

The peat which has been treated, and after being reduced to the condition of a more or less solid cake by an ordinary dewatering process, of which filter

pressing is typical, is subjected to an electric current, and simultaneously to an appropriate pressure in a space of gradually decreasing volume. The process may be conveniently carried out in a filter press of the known kind, in which when the cakes are formed they are subjected to compression for further dewatering, the process when so carried out permitting of securing more quickly, and at a lower pressure the result which could be secured by simple pressure, (see, for instance, patent No. 4684 of 1911). In certain experiments on a peat of an average degree of decomposition a moderate pressure only in excess of the cake-forming pressure, and with this a relatively low voltage, gave the best results, and reduction of a filter press cake from 68 per cent. water content to some 55 per cent. water content (a condition of relative hardness and dryness of advantage for gasification with by-product recovery), was found quickly to take place for an energy consumption small in relation to the energy available in the peat so treated. In carrying out the process in one form, therefore, the customary filter presses are replaced by filter presses with collapsible chambers and provided with electrodes in each chamber to pass current through the cakes when formed. Cakes of wet carbonized peat are allowed to build therein in the usual way, say by application of fluid pressure of some 100 lb. per square inch, the peat having been cooled to a lukewarm condition before entering the filter press. When the cakes have formed, the current is applied (say at 50 volts, and at a current density of some 50 amperes per square foot), and the cakes are squeezed (say at a pressure of 250 lbs. per square inch) for such time as is determined by the electric energy to be so employed, or the degree of dryness desired. Four claims.

British Patent No. 12818 (1914).—Dr. C. Otto.

Process for Separating Tar and Ammonia from Gases Derived from the Carbonization of Fuel.

According to the invention the crude gases are cooled and washed in a washer with cold water sprayed in the direction opposite to that in which the gases move. The cold water entering the washer from above washes the tar from the gases flowing in the opposite direction, and absorbs more and more ammonia on its way downwards, until it arrives at about the middle part of the washer. In the lower part of the apparatus, in consequence of the action of the hot gases the volatile ammonia is expelled again from the washing water, so that the latter finally issues from the washer charged only with fixed ammonia compounds. There is, therefore, formed in the middle part of the apparatus a zone where the washing water has as high a content of ammonia as possible under the conditions, and if water is continuously withdrawn from this zone at such a rate that the quantity of ammonia removed in it per unit time is substantially the same as is introduced during that time by crude gases entering washer, the process may be continuous. The water thus removed is separated from tar and led directly to a still, to be further worked up in known manner. The hot washing water running away from the bottom

of the washer contains, besides the tar, the fixed ammonia compounds; after the tar has been separated, this water is pumped to a cooling tower, where such a quantity of it is evaporated as corresponds with the quantity of water precipitated in the process, so that there is no effluent beyond the water running away from the still. In order to avoid any loss of ammonia with the gases issuing from the upper part of the washer, there is preferably arranged behind this washer a supplementary washer, fed with a spray of cold fresh water, the quantity of which may be so measured that it corresponds with the quantity of water passed into the still, if the amount of water corresponds with that precipitated in the process is entirely evaporated in the cooling tower. The water running over the cooling tower becomes richer in fixed ammonia compounds, and as it is used again as washing water, a portion is always conducted into the still with the water passing thereinto; both the volatile and the fixed ammonia compounds are therefore recovered substantially entirely, except for unavoidable losses. The upper and lower part of the washer may also be represented by washers placed side by side; so also a rotary washer may be used, in which a part of the washing water is withdrawn from a middle zone. Two claims.

British Patent 3677 (1915).

Improvements in By-Product Recovery from Gas Producers.

N. Testrup, London, and T. Rigby, Dumfries, Scotland.

Consists in an improved method of utilizing the tar condensed from the gases of producers or blast furnaces using fuels such as peat or bituminous coal, containing volatile matter, according to which, after distilling oil from the tar, the residual pitch is added again as fuel, thereby increasing the total yield of oil, and further consists in improved methods of increasing the yield of by-products, and decreasing fuel consumption. The pitch obtained from the distillation of the tar is distributed to the producer in such a manner that it is subjected to distillation by means of the outgoing gas, care being taken that the pitch is completely distilled before the residue reaches the zone of combustion. In order to achieve this result, the pitch is mixed as intimately as possible with the fuel, either in the liquid form by spraying, or by mixing with the fuel in the form of small pieces. In the latter case, the pitch is preferably broken into pieces about the size of an egg, or of such size as to be uniform with the particles of fuel by which the gas producer is fed. The depth of the gas producer is preferably so arranged that the distillation of the pitch is complete before the residue reaches the combustion zone, which results in a high proportion of the volatile matter distilled from the pitch being carried forward in the producer gas as condensable products. The final result is that the tar, which is condensed from the gas in the tar extracting apparatus gives a higher yield of oil than is produced under ordinary conditions. Consequently, when such tar is distilled in the distillation plant, a much higher proportion of oil is given off than is the case with tar normally produced from the fuel. Four claims.

SULPHATE OF AMMONIA.

Estimated yield of 19 Ontario and Quebec Bogs, if entirely used to produce Ammonium Sulphate.

BOGS	Est. fuel production with 25% moisture TONS	% Nitrogen	Est. Production Sulphate of Ammonia TONS	Valuation at $65 per Ton
ONTARIO				
Alfred	9,369,000	1.76	407,742	26,503,230
Welland	4,106,000	1.44	146,204	9,503,260
Newington	6,208,800	1.76	270,207	17,563,455
Perth	5,126,000	1.80	228,221	14,834,365
Brunner	1,172,130	1.73	50,142	3,259,230
Brockville	1,694,157	2.41	100,959	6,562,335
Rondeau	1,047,544	2.77	71,751	4,663,815
Holland	8,218,931	2.67	542,633	35,271,145
Richmond	2,788,000	2.00	137,880	8,962,200
Luther	7,443,000	1.67	307,358	19,978,270
Marsh Hill	9,620,000	2.18	518,575	33,707,375
Stoco	1,345,000	2.37	78,822	5,123,430
QUEBEC				
*Large Tea Field	4,823,867	2.0	238,564	15,506.660
Small Tea Field	3,315,507	2.0	163,968	10,657,920
Lanoraie	4,751,500	2.0	234,985	15,274,025
St. Hyacinthe	3,665,980	2.0	181,301	11,784,565
L'Assomption	1,760,000	2.0	87,040	5,657,600
St. Isidore	2,242,000	2.0	110,878	7,207,070
Holton	2,999,000	2.0	148,305	9,639,825
	81,696,416		4,025,535	$261,659,775

*In addition to the yield of sulphate of ammonia, account must be taken of the gas produced during its manufacture, which would be available for power purposes. Mr. B. F. Haanel, in Peat, Lignite and Coal, estimates that the gas thus available in working the Large Tea Field bog for sulphate of ammonia, would produce 4,000 B.H.P. continuously for 86 years, a total of 344,000 B.H.P. years. The total power gas available in conjunction with the utilization of all the bogs above mentioned would amount to over 5,000,000 B.H.P. years.

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